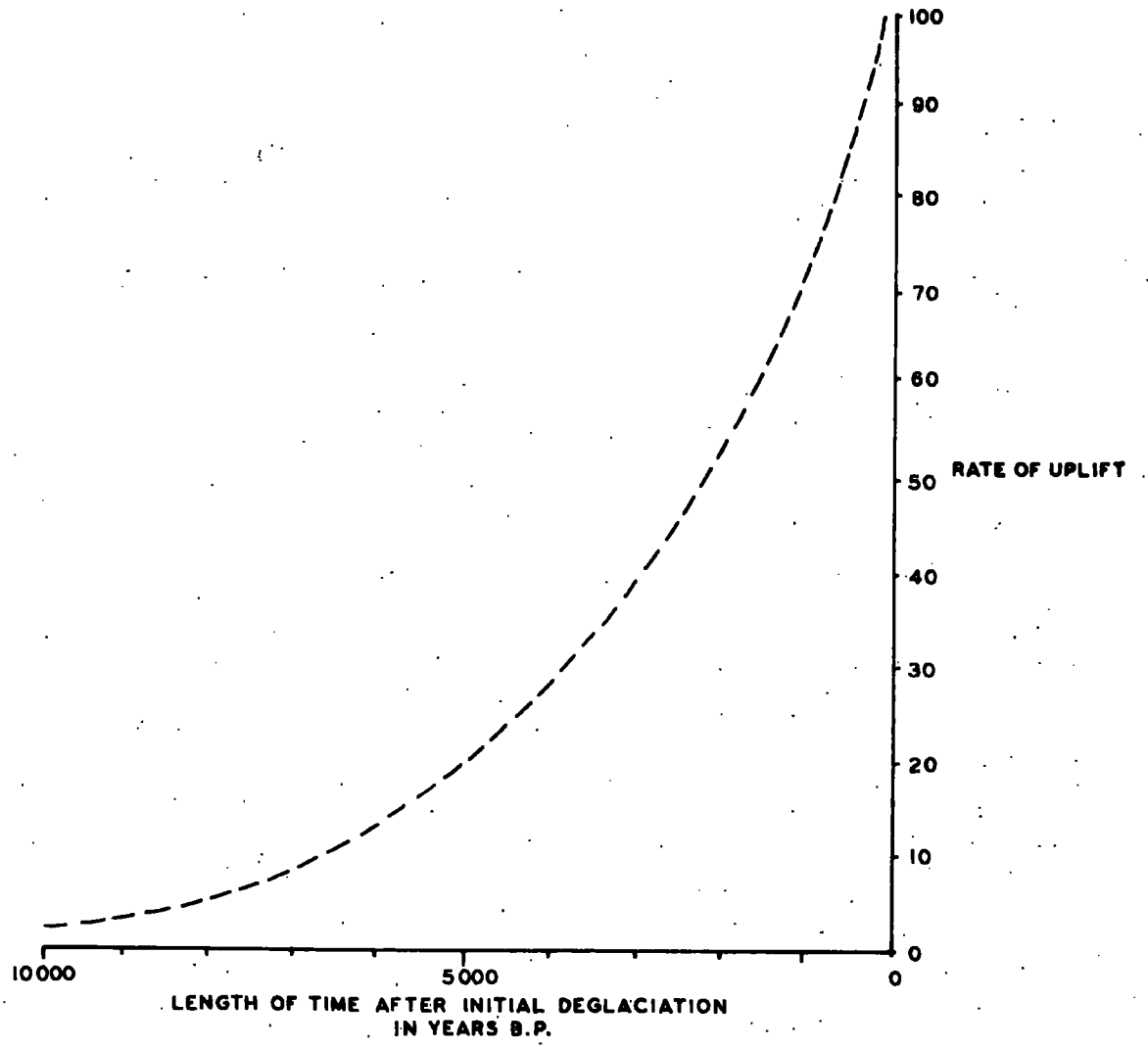
Quaternary sea level change, Lake formation, and associated glacial events, with special reference to the lower tees basin

Lockery, Andrew R.

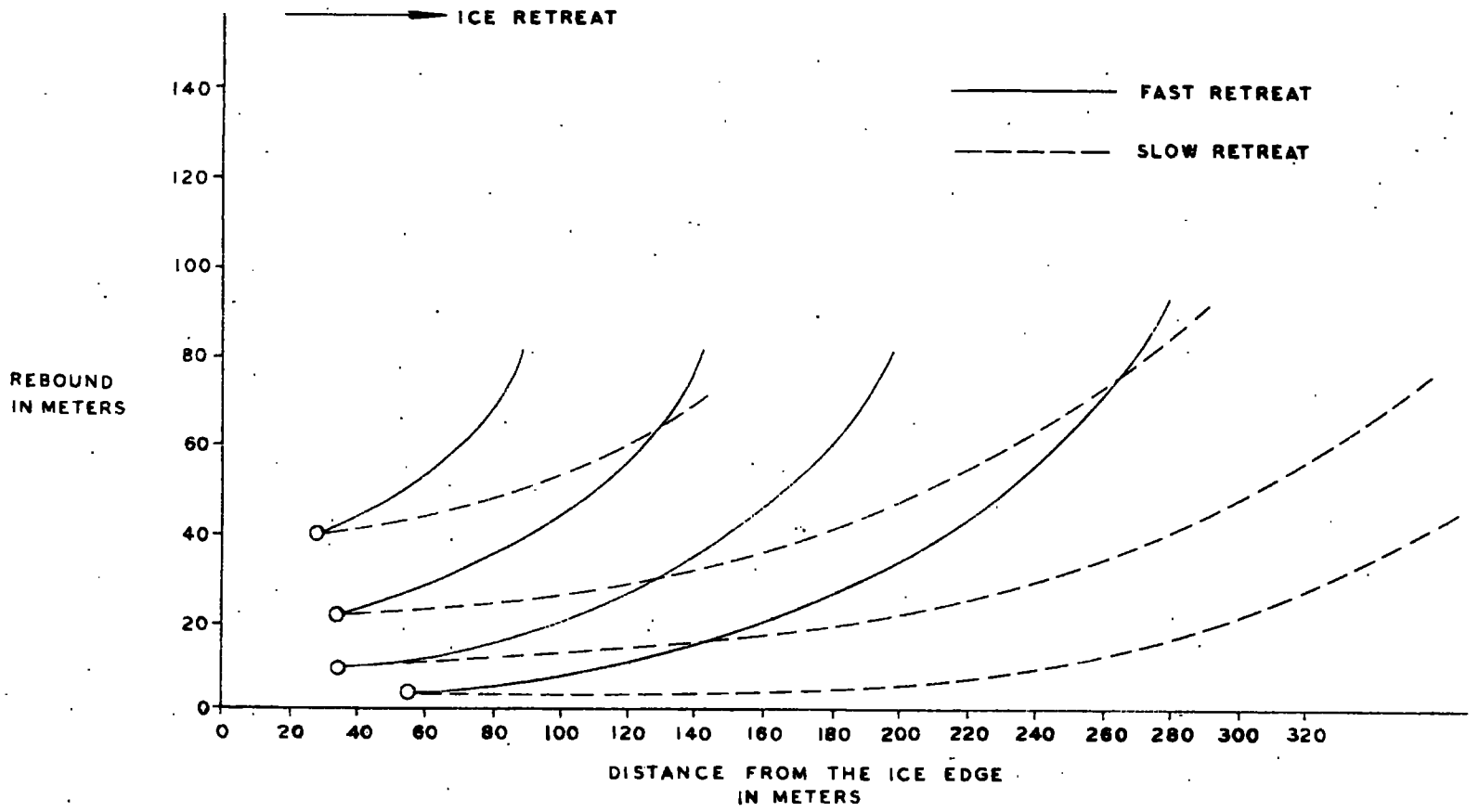
ISOSTATIC UPLIFT



ADAPTED FROM NANSEN 1927

FIG. 1.

THE EFFECTS OF DIFFERENT RATES OF GLACIER RETREAT ON THE AMOUNT OF POST GLACIAL REBOUND



AFTER ANDREWS 1968

FIG. 2

ISOBASES OF LATE AND POSTGLACIAL RAISED SHORELINES IN HIGHLAND BRITAIN

100' — — — LATE GLACIAL

— · — · — POSTGLACIAL NEOLITHIC

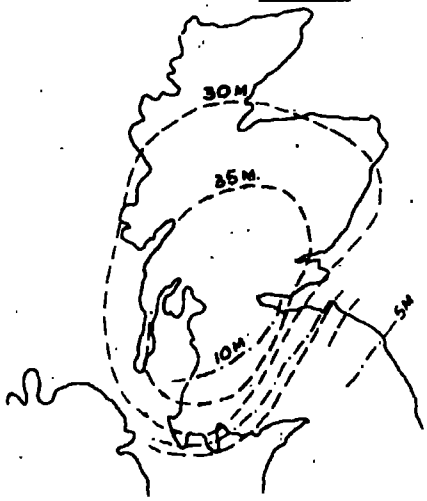
WRIGHT

0 100 MILES

— — — LATE GLACIAL ISOBASES(FEET)

— · — · — LITTORINA BEACH ZERO ISOBASE

MOVIUS



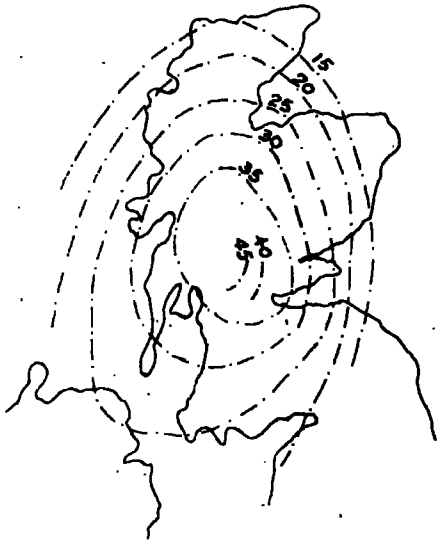
0 30 MILES

— — — LATE GLACIAL 100' BEACH

— · — · — POST GLACIAL 25' BEACH

ISOBASES (METERS)

DONNER



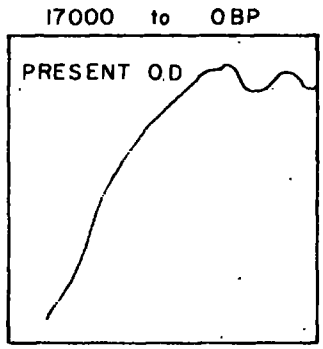
— · — · — POST GLACIAL UPLIFT (IN FEET)

SISSONS

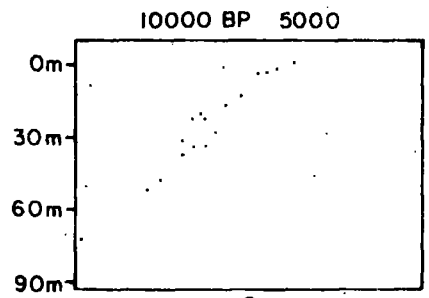
AFTER SMITH

FIG.3

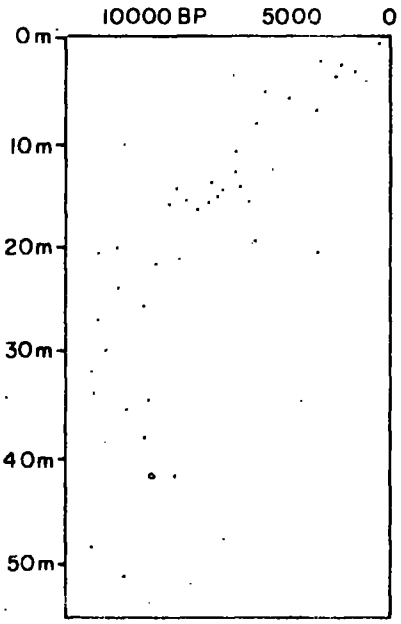
GRAPHS DEPICTING THE EUSTATIC RISE OF SEA LEVEL FOLLOWING THE LAST ICE AGE



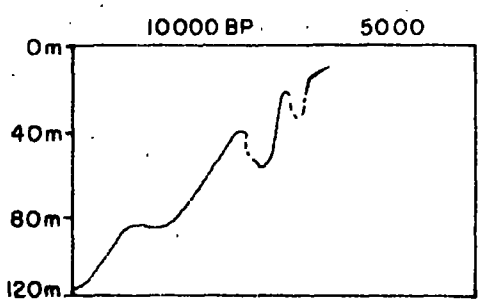
1.



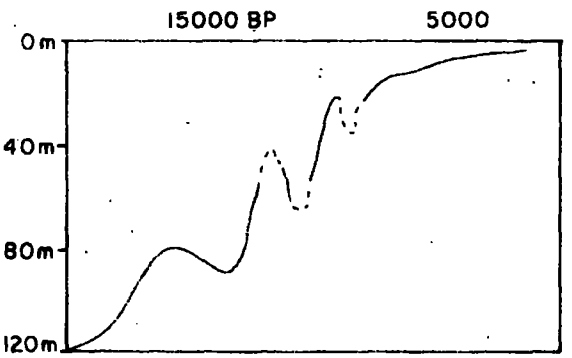
2.



3.



4.

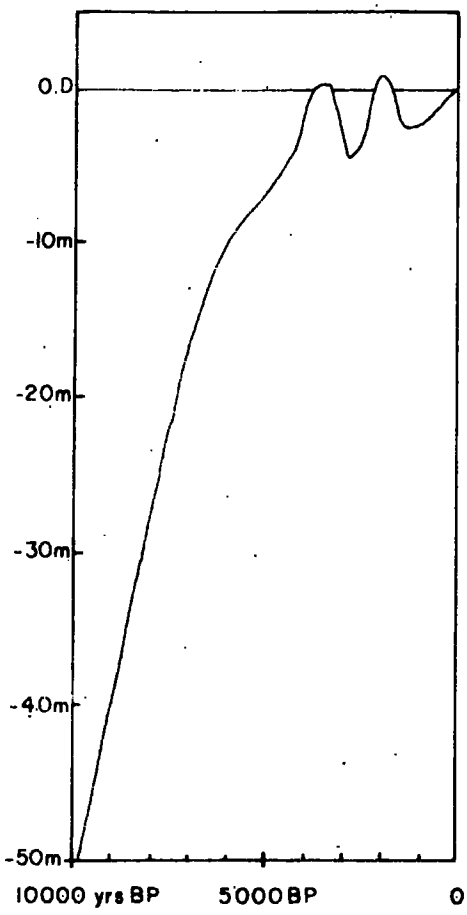


5.

1) Fairbridge 1961
2) Godwin and Suggate 1958
3) Shepard and Suess 1956
4) Curray 1960
5) Shepard 1960

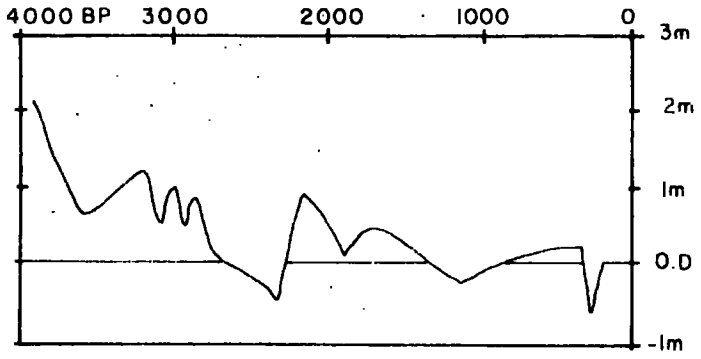
FIG. 4

GRAPHS DEPICTING THE EUSTATIC RISE OF SEA LEVEL FOLLOWING THE LAST ICE AGE

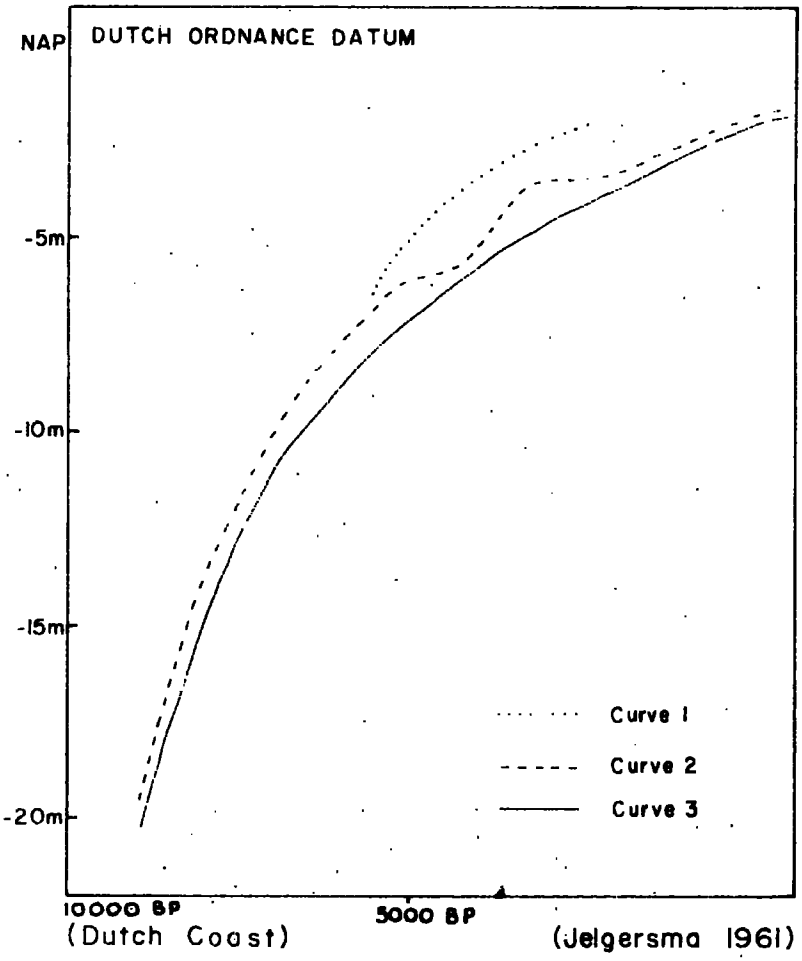


Sea level change in the Fenlands of East Anglia

(Godwin 1940)



(New Zealand) (Schofield 1960)



(Dutch Coast) (Jelgersma 1961)

FIG. 5

RETREAT OF THE WÜRM ICE SHEET

D ..... DISTRICT
– – – – LAMMERMUIR-STRANRAAR
——— N.E. ANTRIM I.O.M. CUMBERLAND

Mc CALLIEN

——— VALLEY
– – – – HIGHLAND
—·—·— NEWDRIFT

MOVIUS

3 DINNET RE-ADVANCE
2 ABERDEEN RE-ADVANCE
1 MORAY FIRTH
– – – STRATHMORE GLACIATION
—·—
—·— OTHER STAGES

SYNGE

..... MORAINE GLACIATION
—·—·— HIGHLAND
– – – – NORTHERN BRITISH RE-ADVANCE

CHARLESWORTH

AFTER SMITH

——— LOCH LOMOND
– – – – PERTH
—·—·— LAMMERMUIR
—·— YORK RE-ADVANCE

SISSONS

FIG. 6

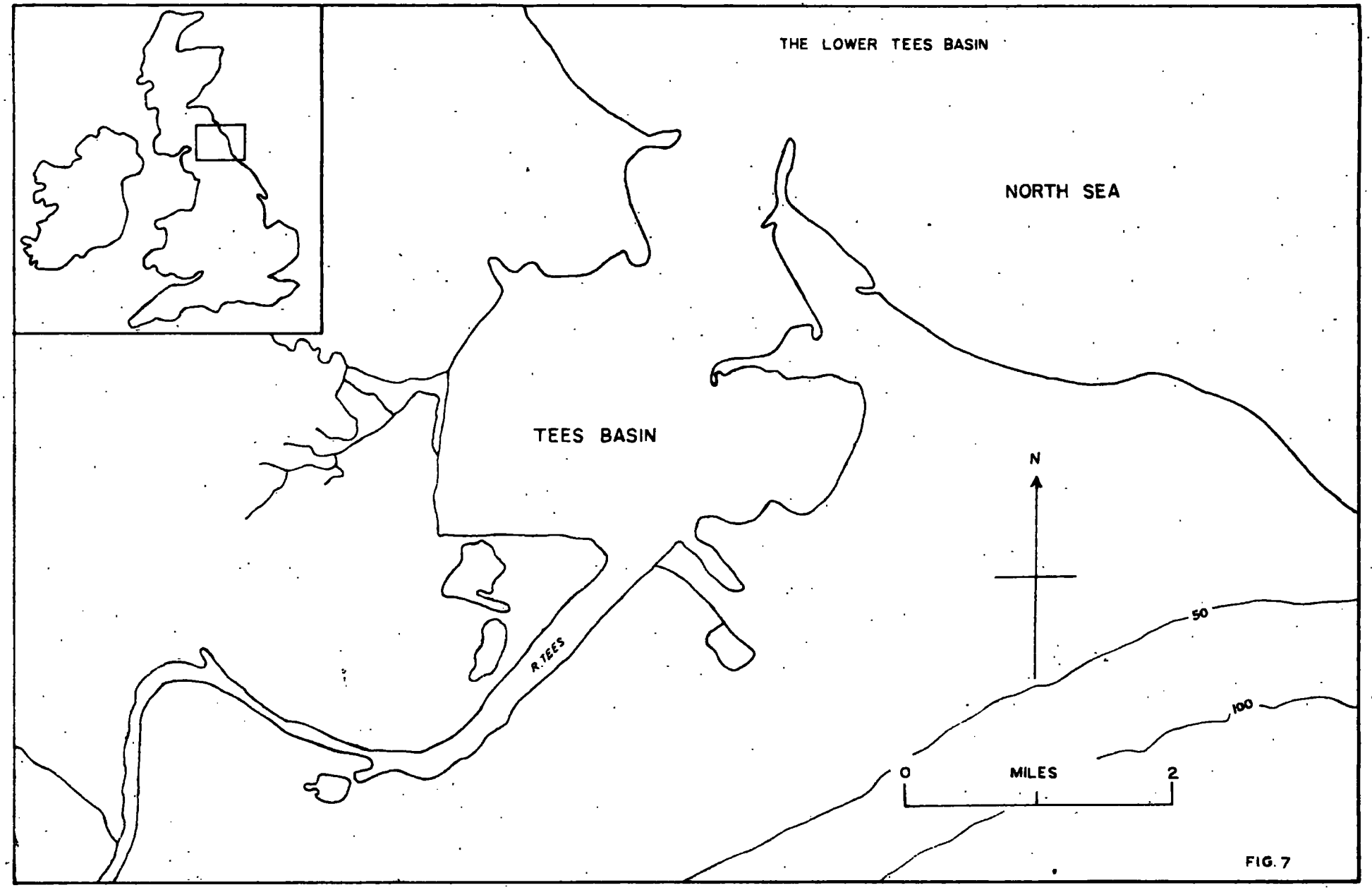
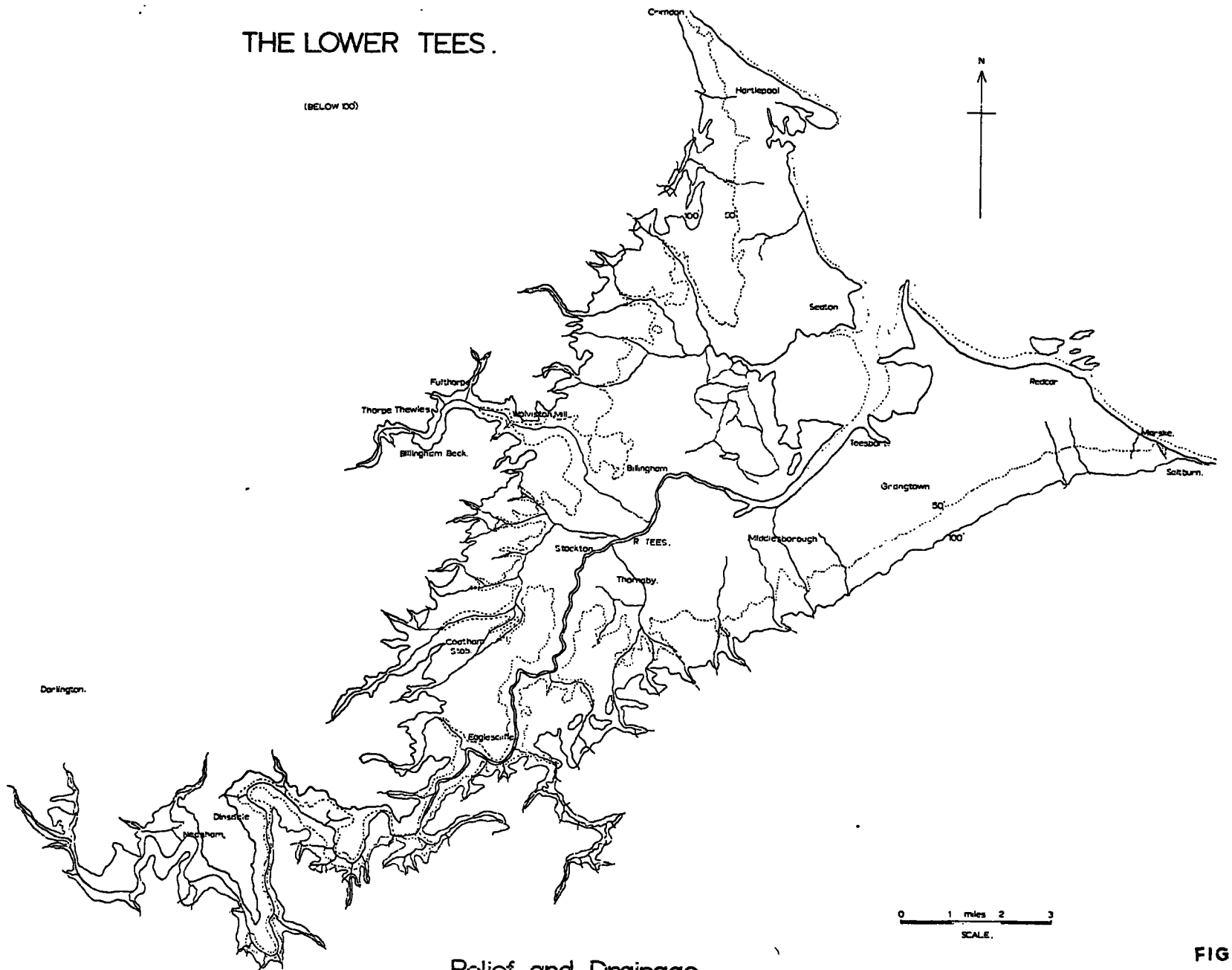
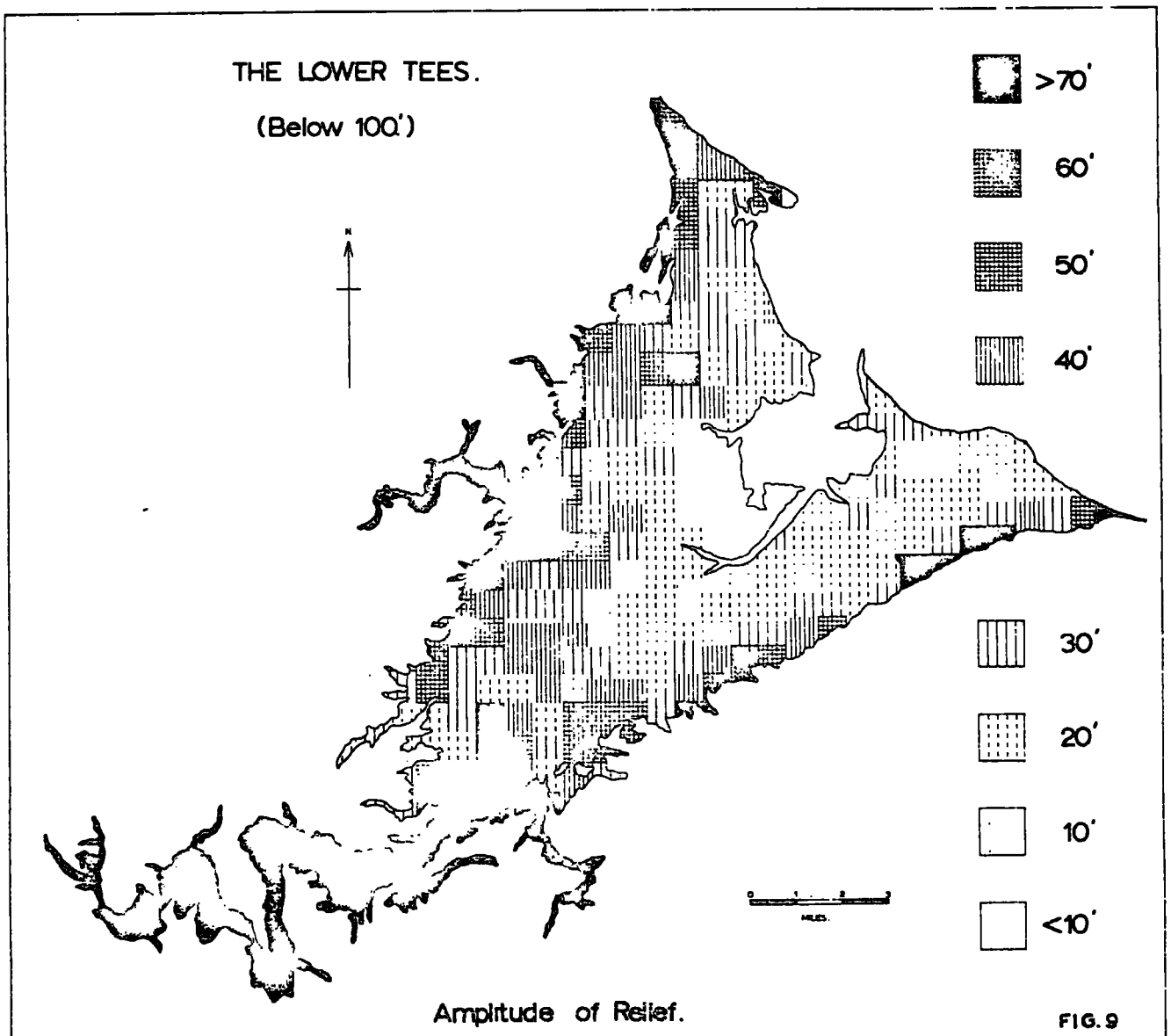

THE LOWER TEES BASIN
NORTH SEA
TEES BASIN
R. TEES
N
50
100
0
MILES
2

FIG. 7



Relief and Drainage.

FIG. 8


THE LOWER TEES.
(Below 100')
>70'
60'
50'
40'
30'
20'
10'
<10'
Amplitude of Relief.
FIG. 9

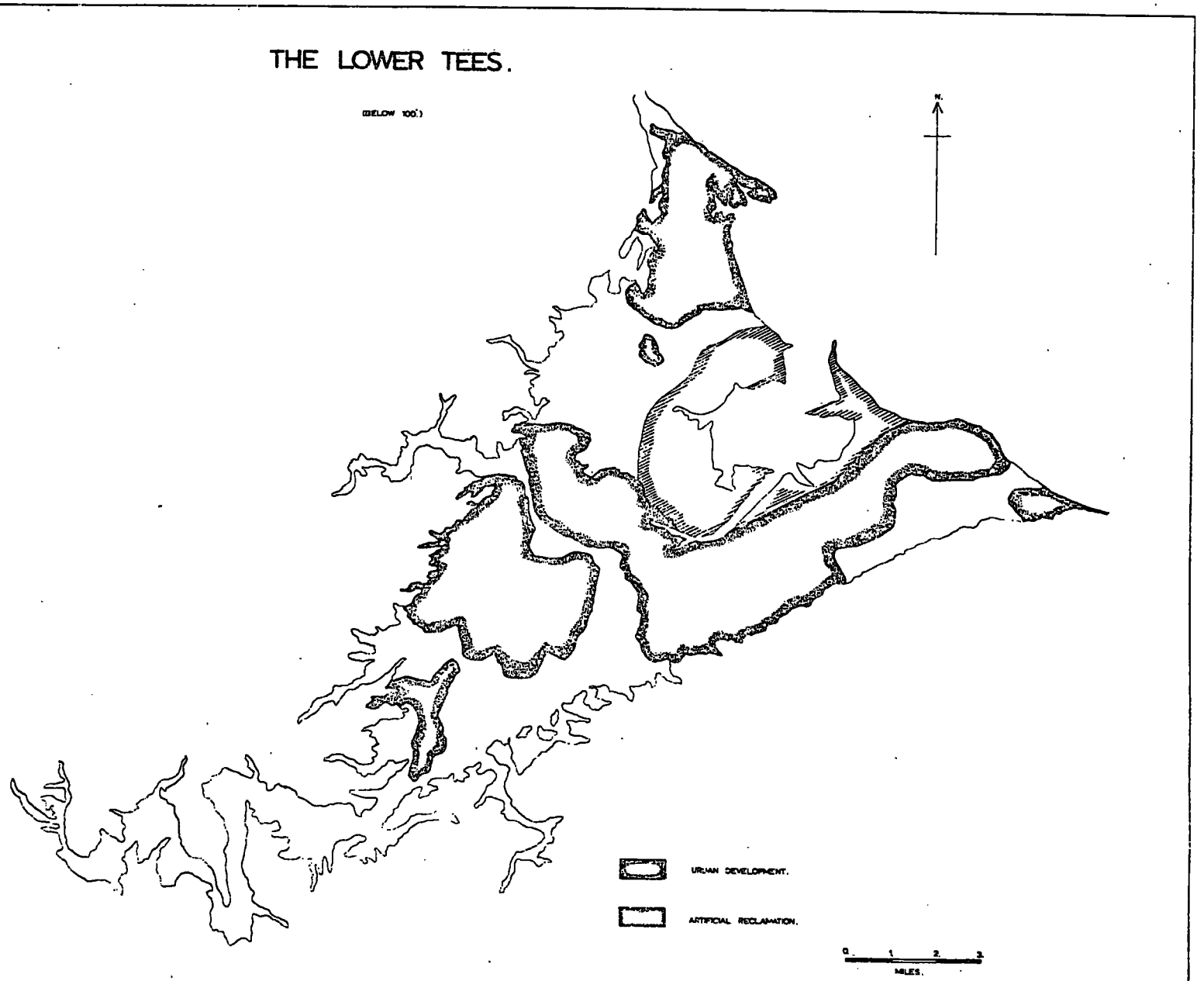
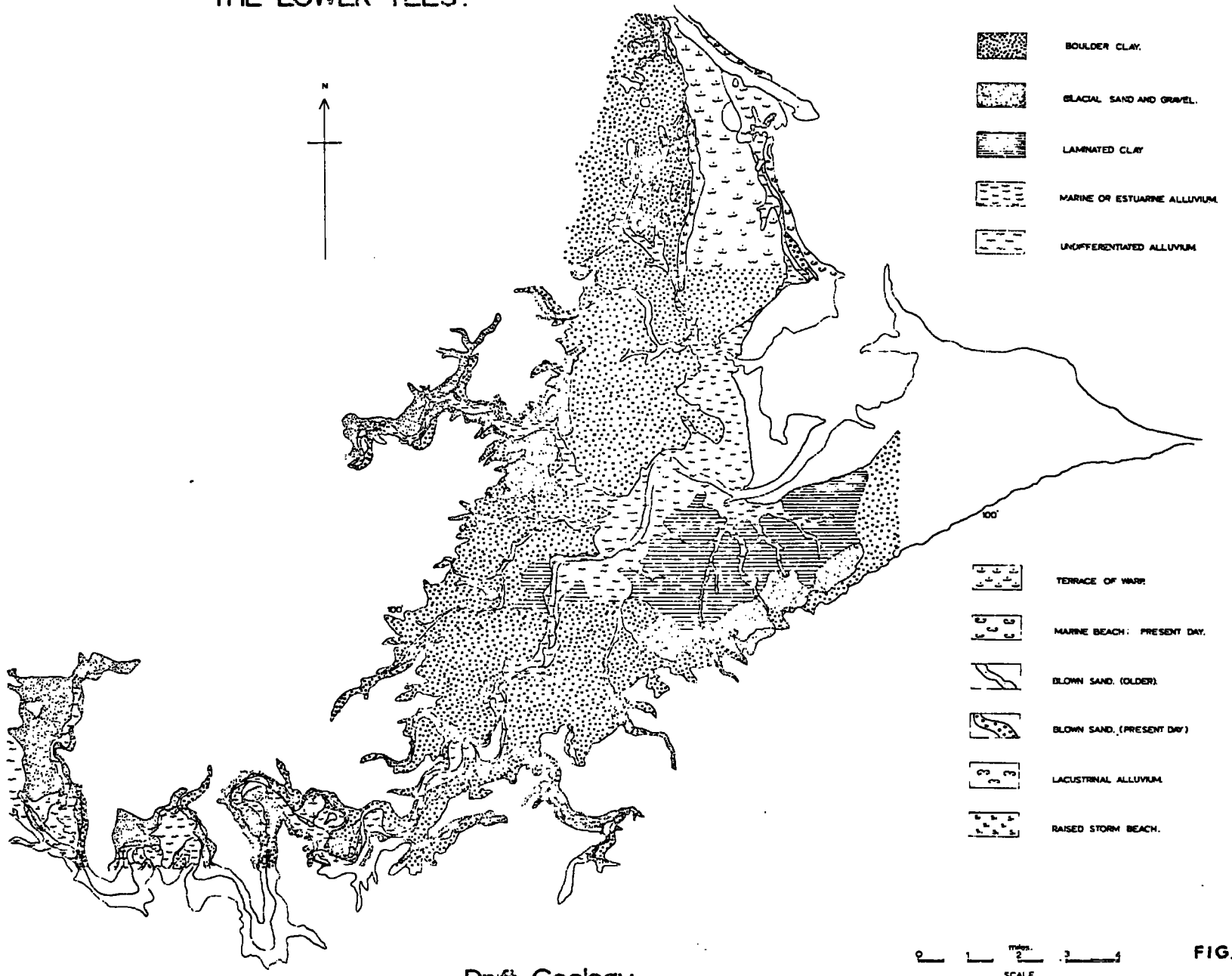


FIG.10

Areas unsuitable for morphometric analysis. (BASED ON FIELDWORK, O.S. 6" MAPS, and 'TEESDALE' CHART 1939)

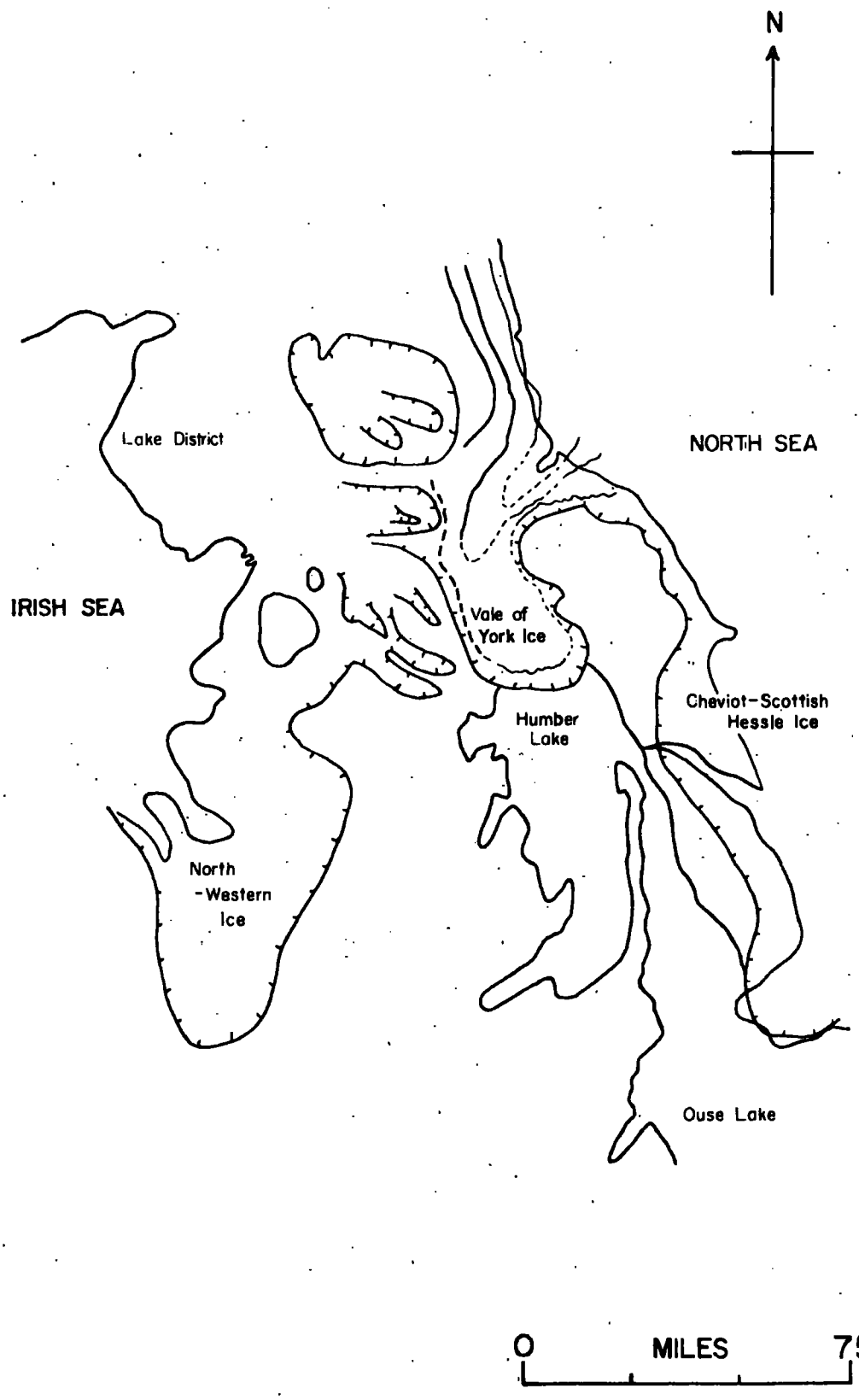
THE LOWER TEES.



Drift Geology.

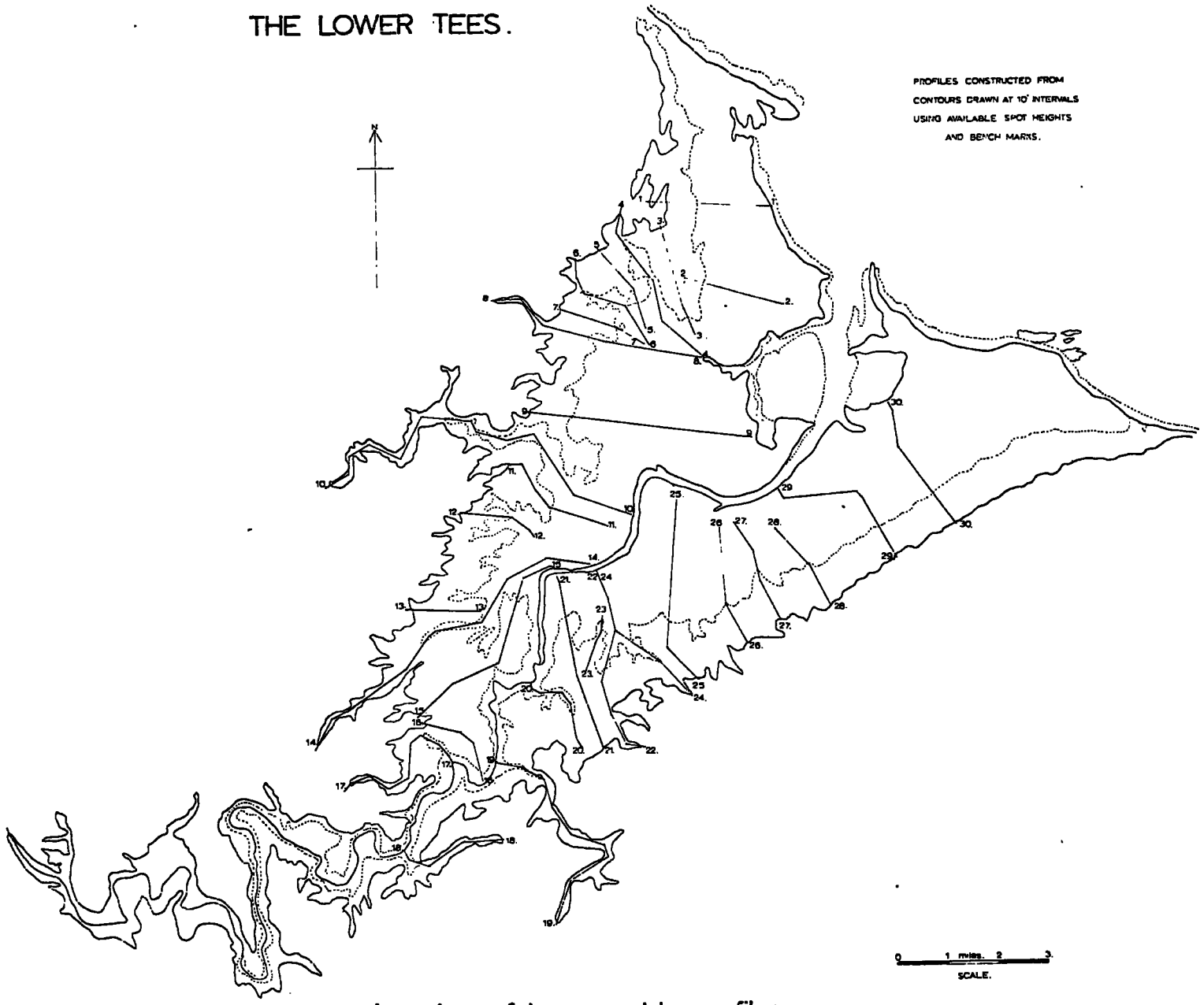
FIG. 11

GLACIAL RETREAT STAGES IN NORTH-WEST ENGLAND



FROM A. RAISTRICK

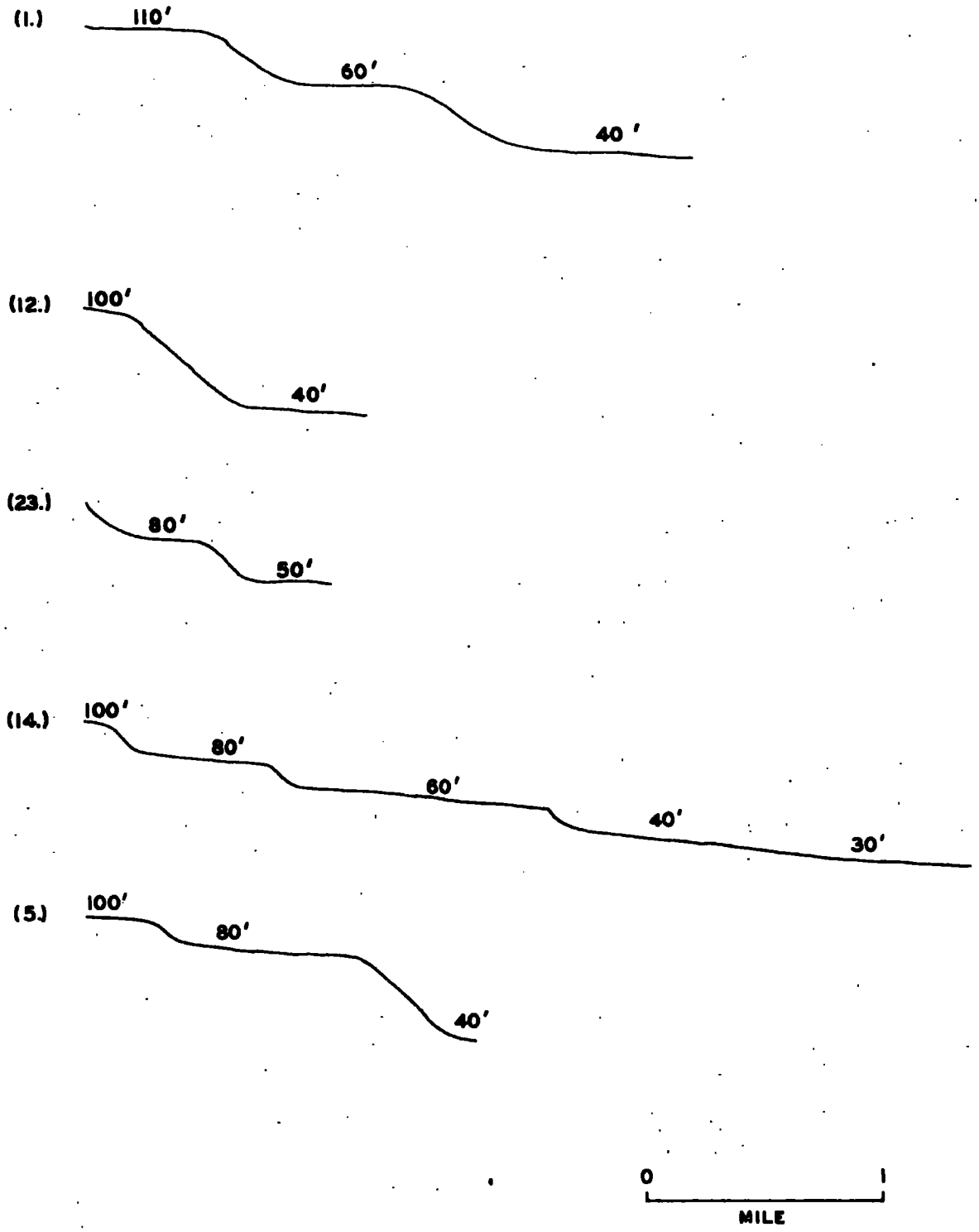
Fig.12



Location of topographic profiles.

FIG.13

PROFILES ACROSS 10 FOOT CONTOUR INTERVALS, CONSTRUCTED FROM SPOT HEIGHTS AND BENCH MARKS.



(NUMBERS REFER TO THOSE ON FIG. 13)

FIG. 14

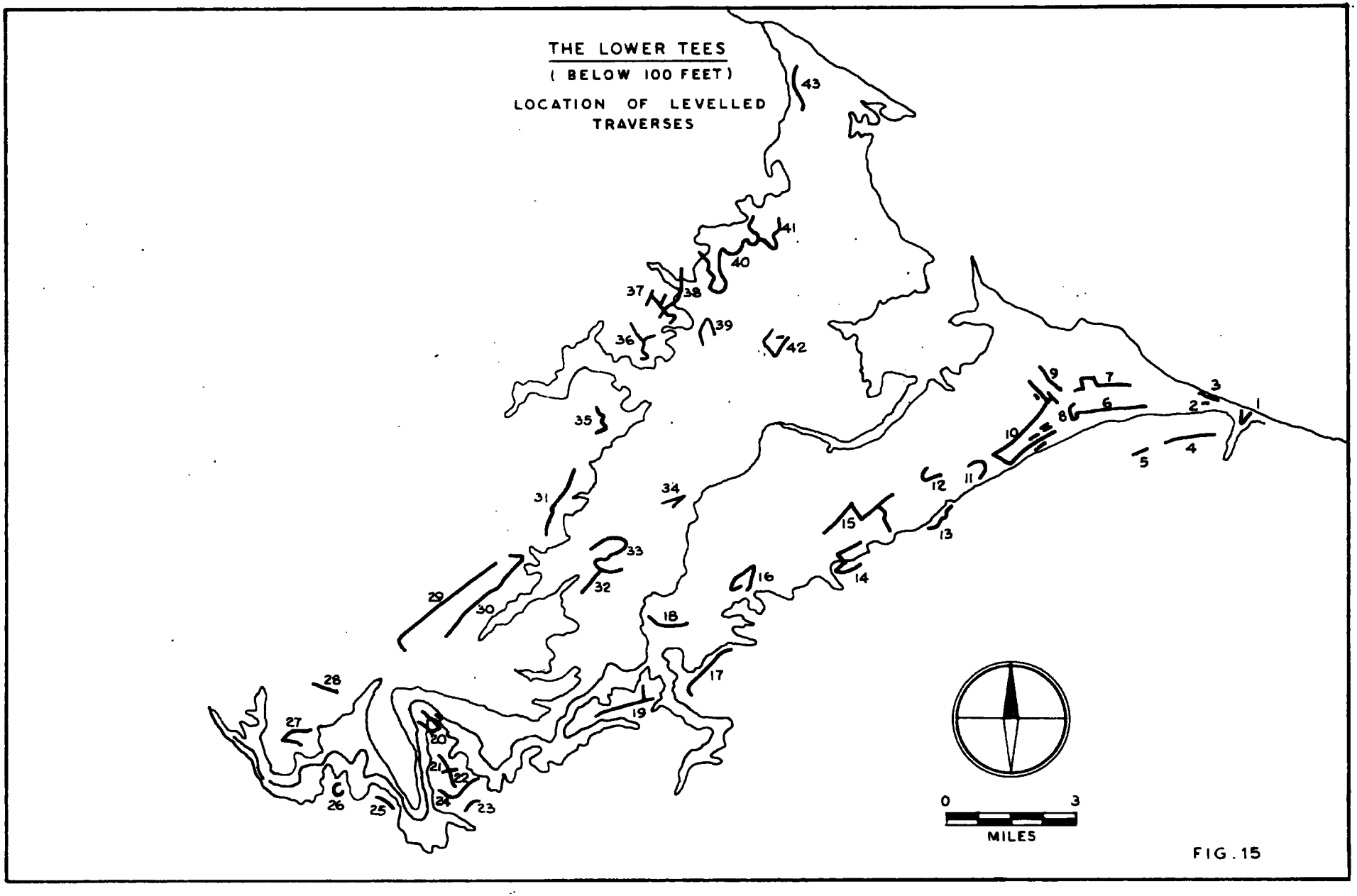
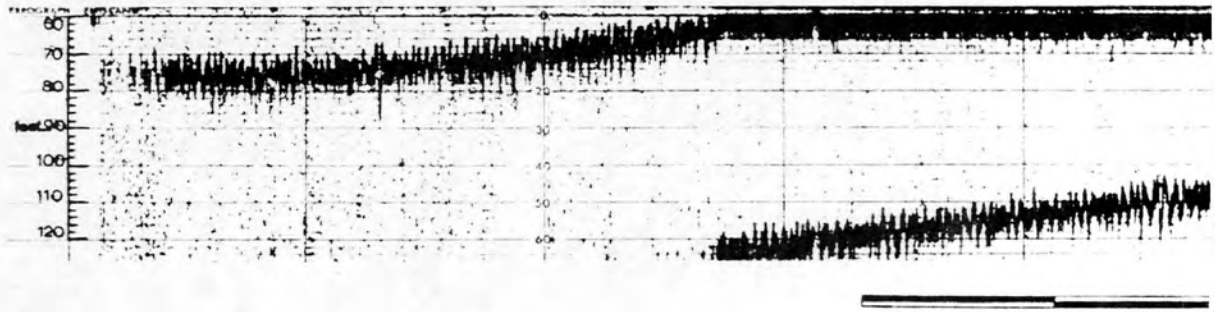

THE LOWER TEES
(BELOW 100 FEET)
LOCATION OF LEVELLED TRAVERSES
43
41
40
37
38
39
36
42
35
31
34
33
32
29
30
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
3
MILES

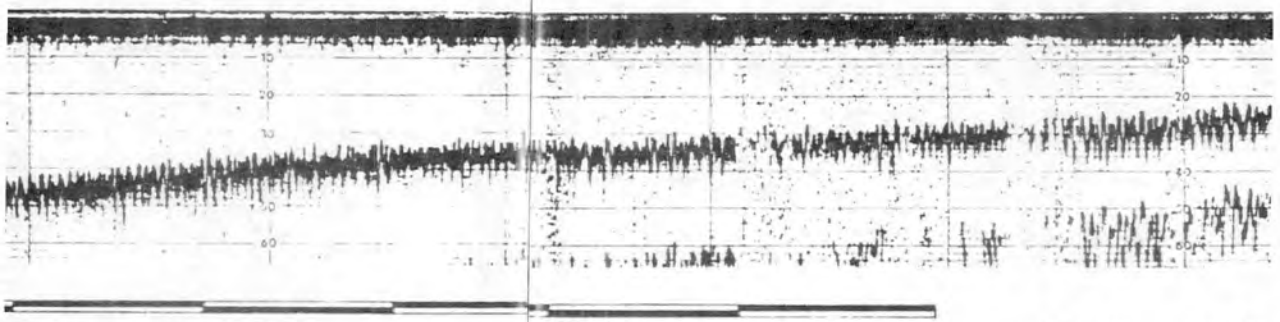
FIG. 15

RANGE 2



HARTLEPOOL

TEES BAY



1 MILE

DIRECTION	North East
SPEED	1·5 Knots
WIND SPEED	Force 5
CONDITIONS	16 ft swell
DATE	6.12.67 11c

ECHO - SOUNDING

THE LOWER TEES BASIN

HEIGHTS OF LEVELLED TRAVERSES SOUTH OF THE R. TEES
— STAINSBY HALL FARM TO SALTBURN

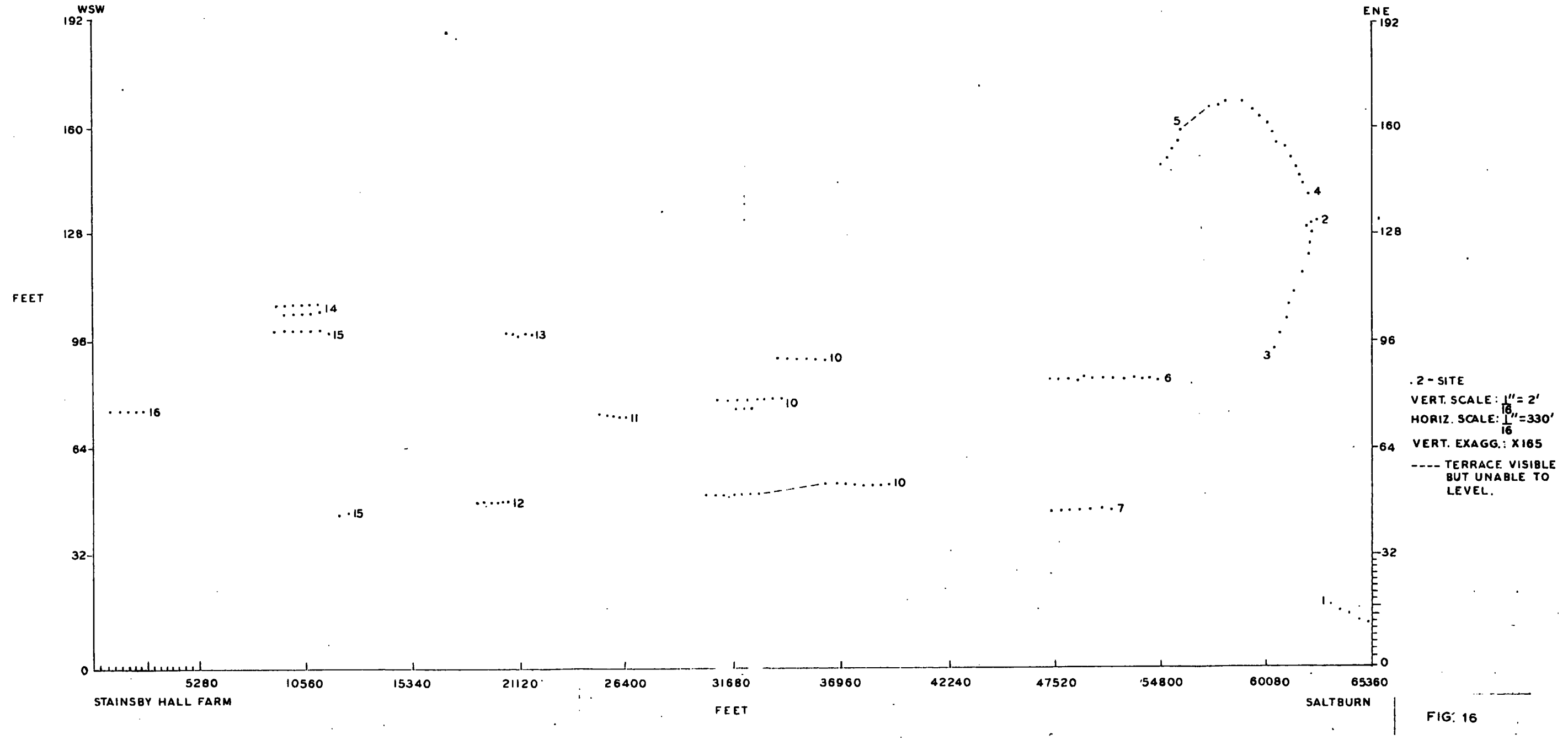


FIG. 16

THE LOWER TEES BASIN

HEIGHTS OF LEVELLED TRAVERSES SOUTH OF THE R. TEES

STAINSBY HALL FARM TO LOW HAIL FARM

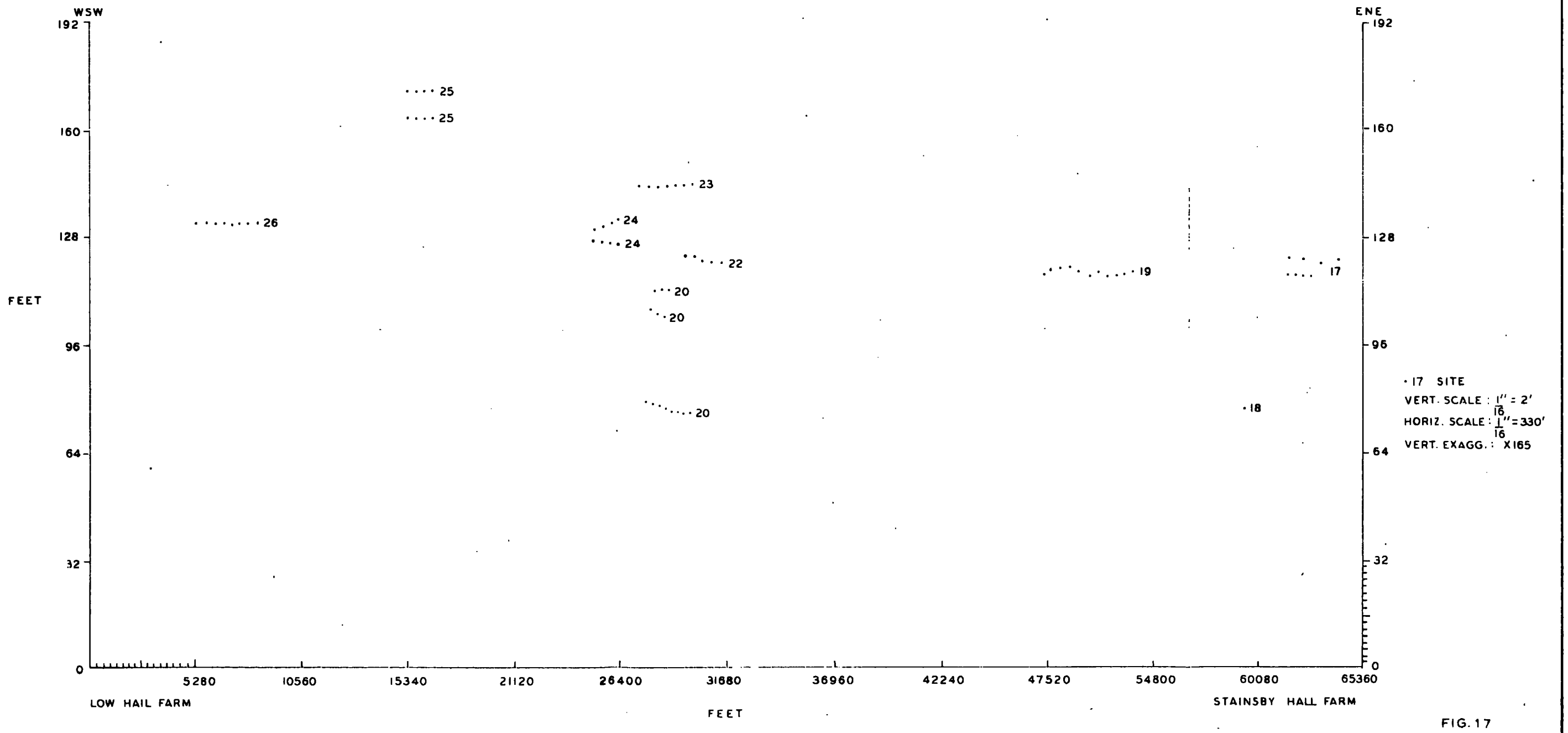


FIG. 17

THE LOWER TEES BASIN

HEIGHTS OF LEVELLED TRAVERSES NORTH OF THE R. TEES
— HURWORTH TO BILLINGHAM BECK

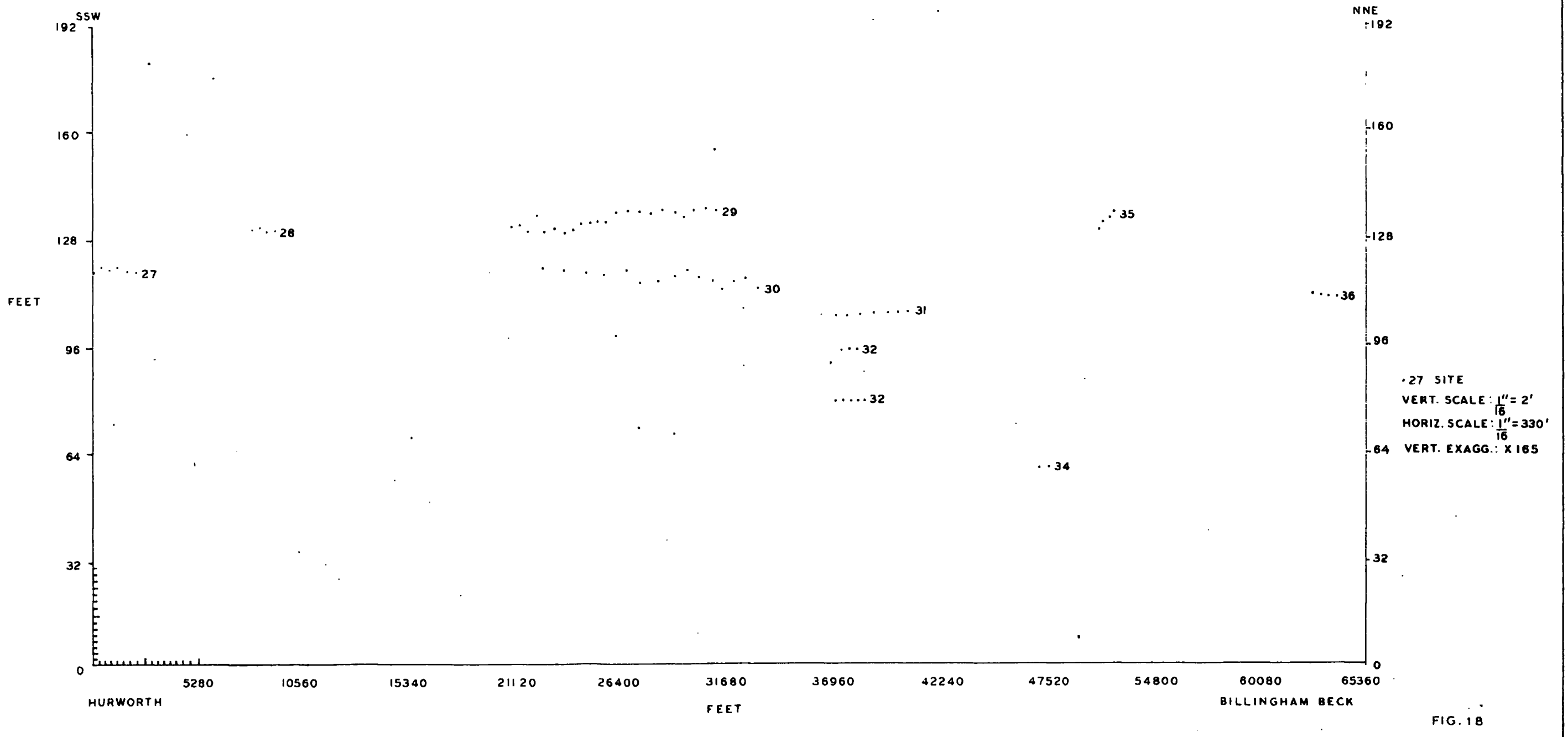


FIG. 18

THE LOWER TEES BASIN

HEIGHTS OF LEVELLED TRAVERSES NORTH OF THE R. TEES
— WOLVISTON TO HARTLEPOOL

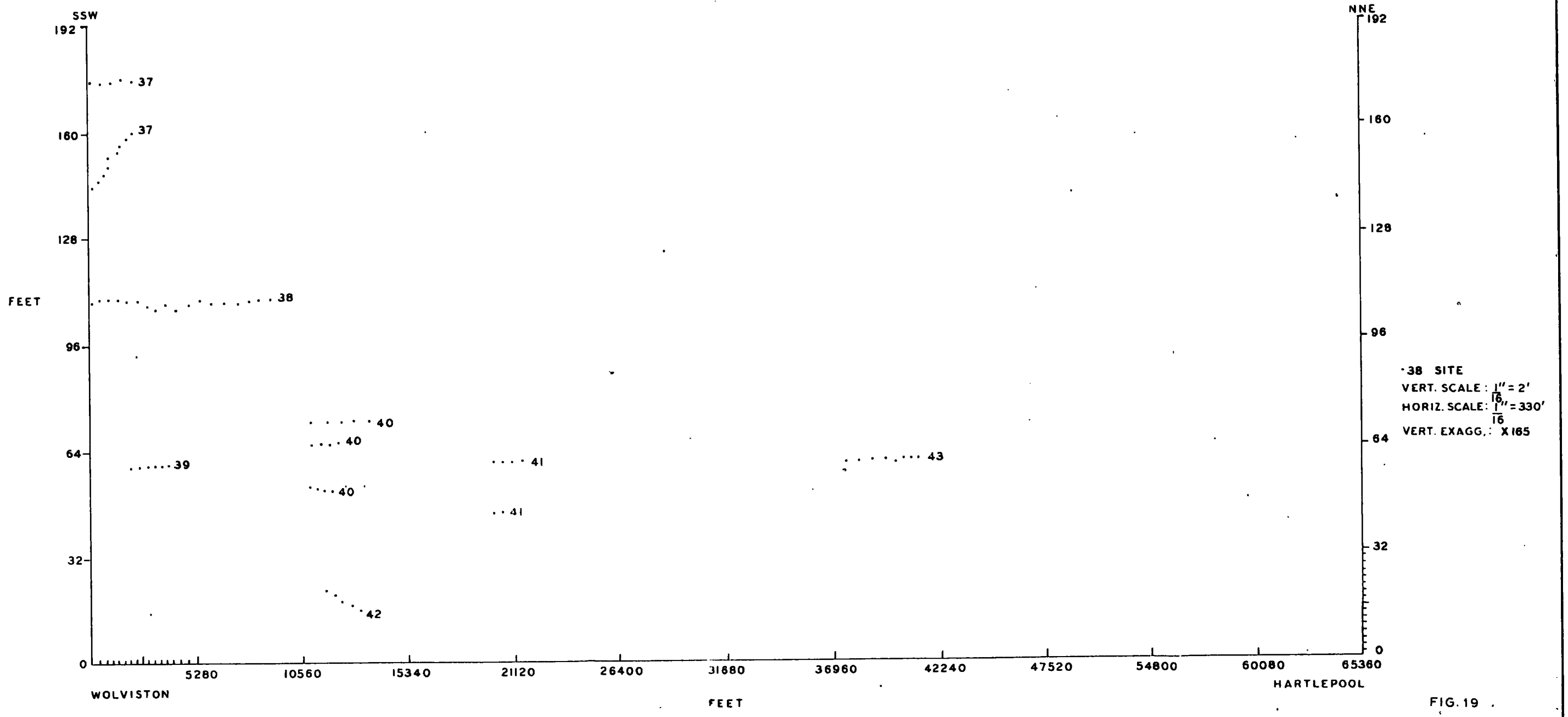


FIG. 19

THE LOCATION OF ECHO SOUNDINGS OFF THE EAST COAST OF HIGHLAND BRITAIN SHOWING THE FIVE MAJOR REGIONS

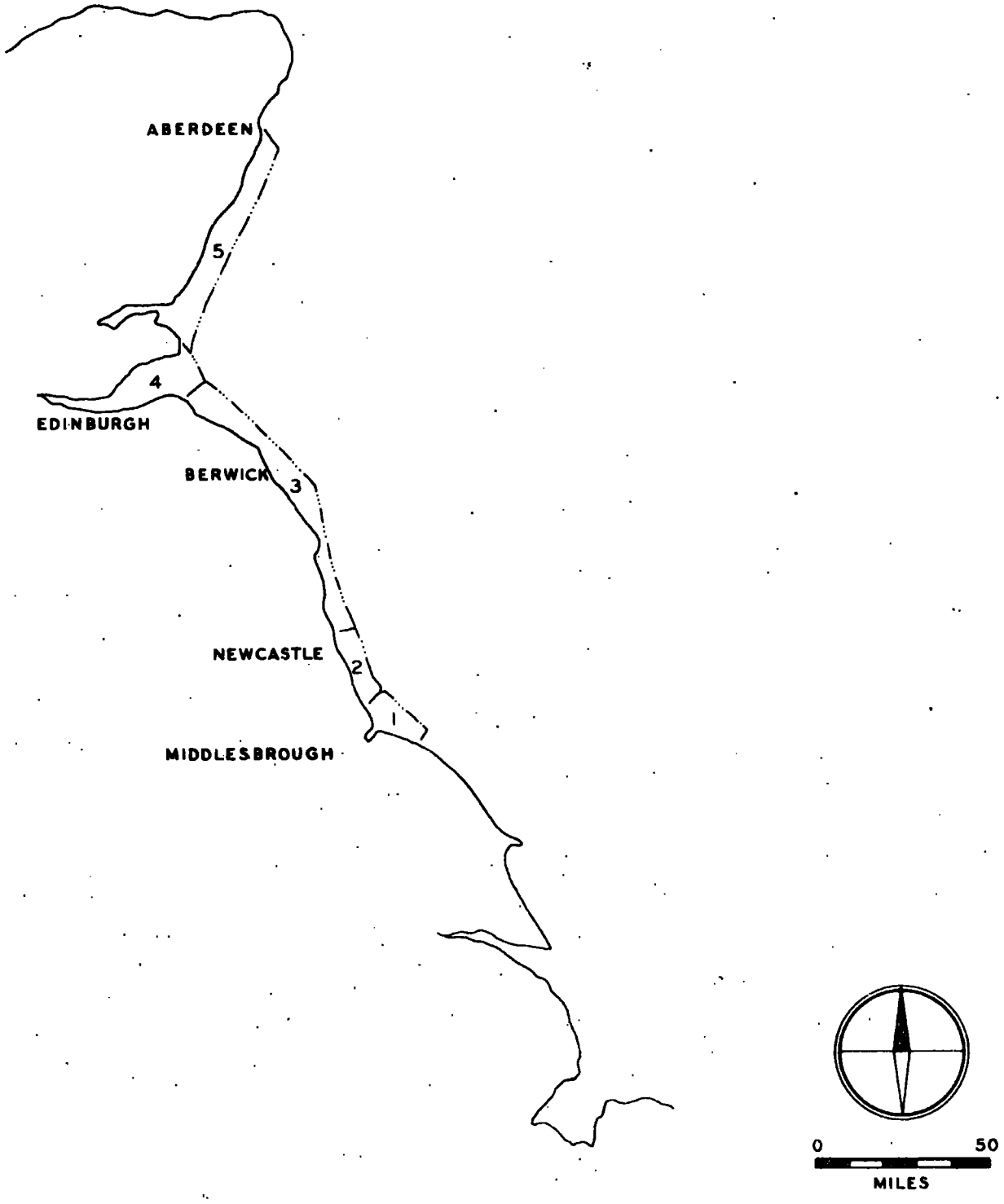


FIG. 21

GROUP I

THE TEES BAY

THE LOCATION OF SOUNDINGS

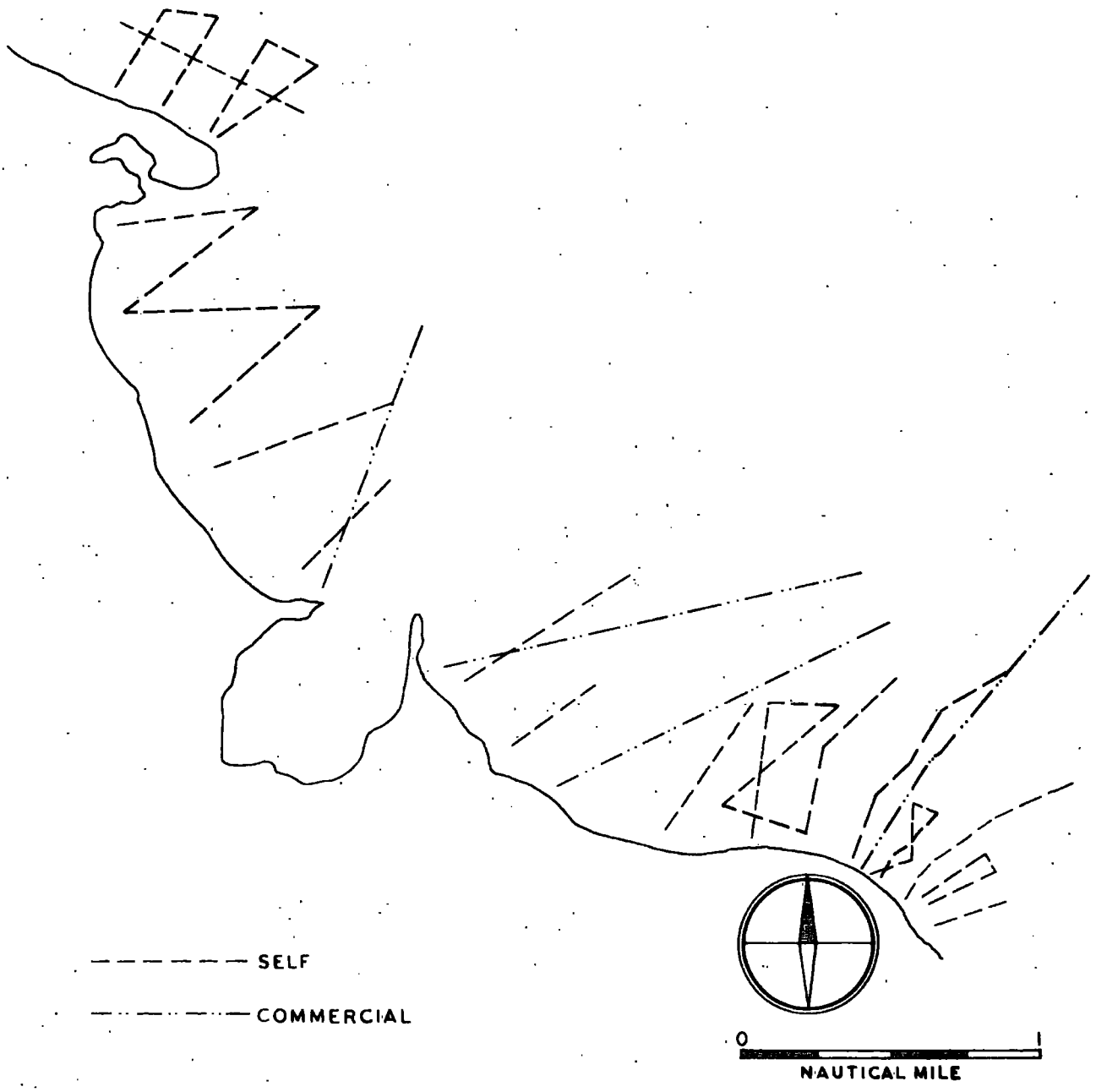
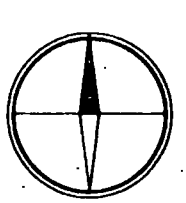


FIG. 22

GROUP 2

TEES BAY TO TYNEMOUTH

LOCATION OF SOUNDINGS



0 5

MILES

— — — — — SELF

— · — · — · — COMMERCIAL

FIG. 23

GROUP 3

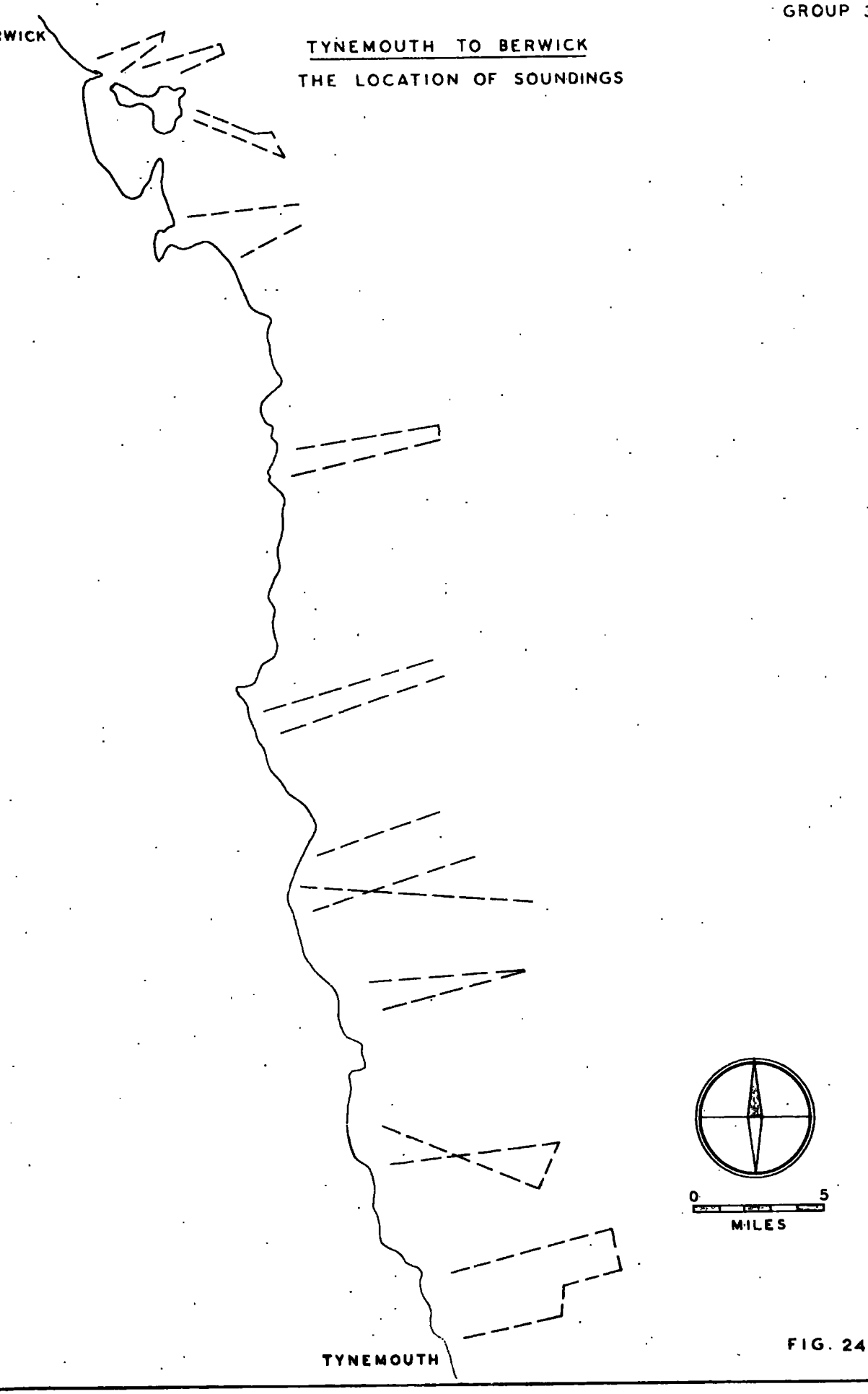


FIG. 24

GROUP 4

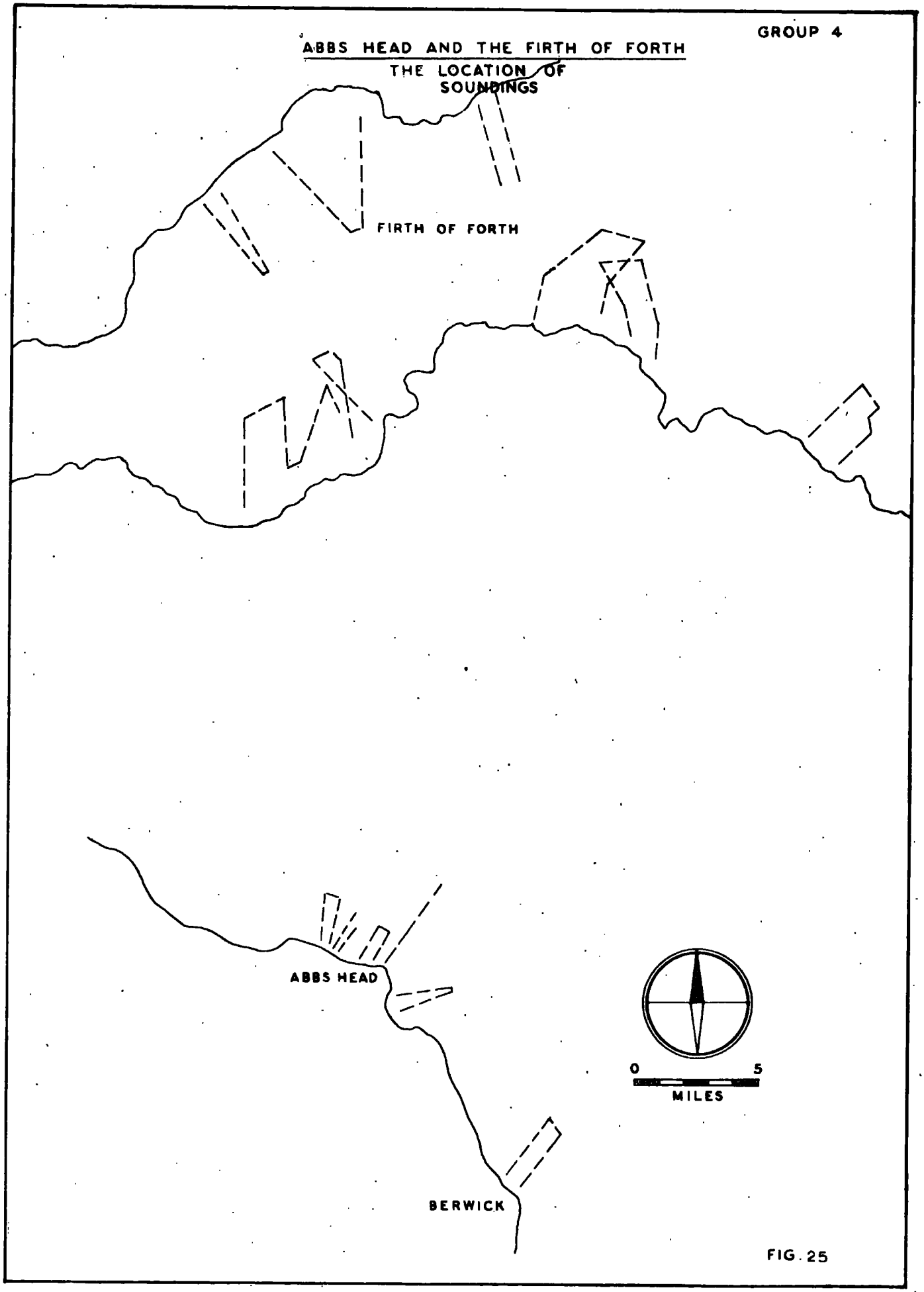


FIG. 25

GROUP 5

FIRTH OF FORTH TO STONEHAVEN

THE LOCATION OF SOUNDINGS

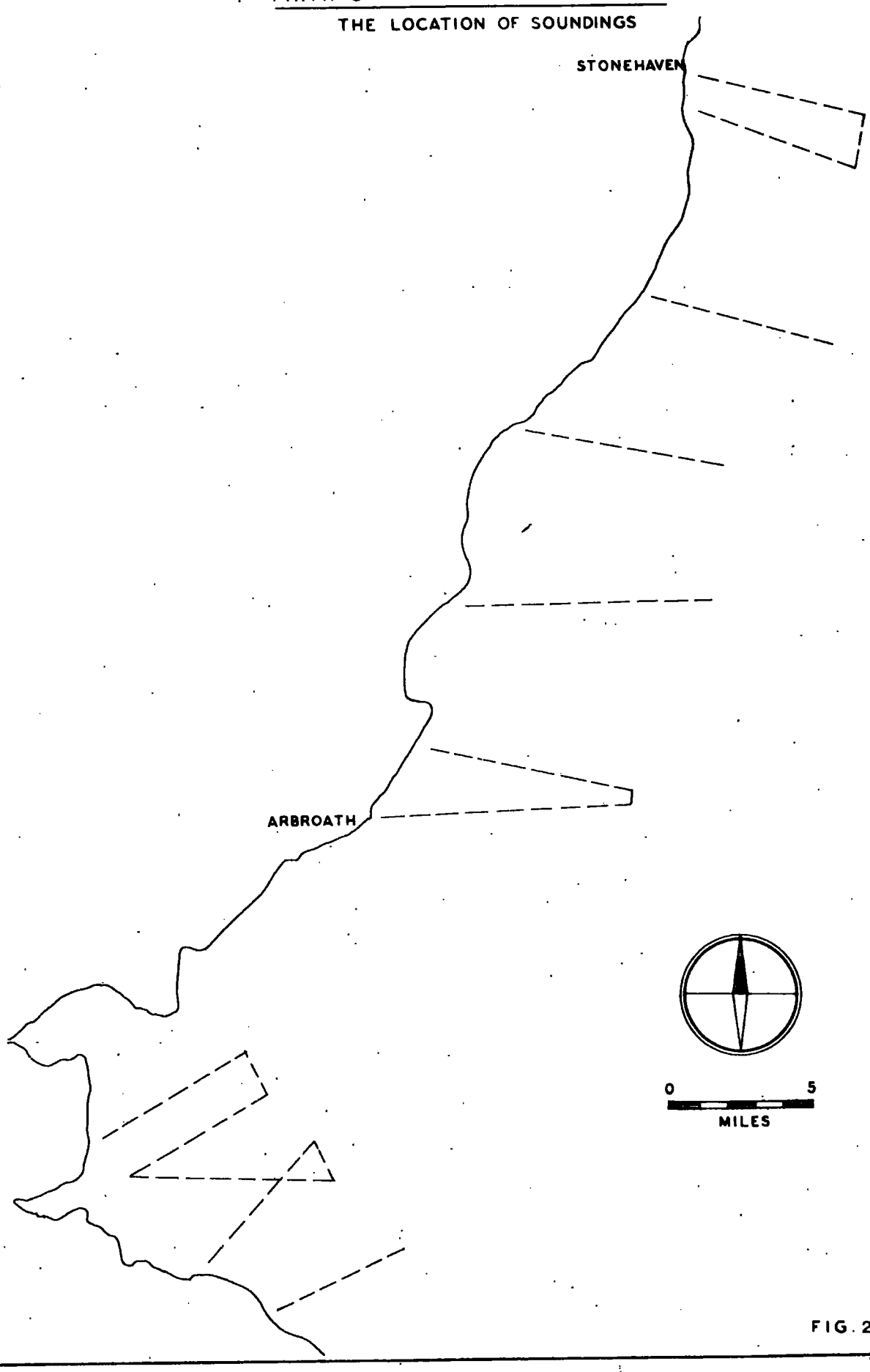


FIG. 26

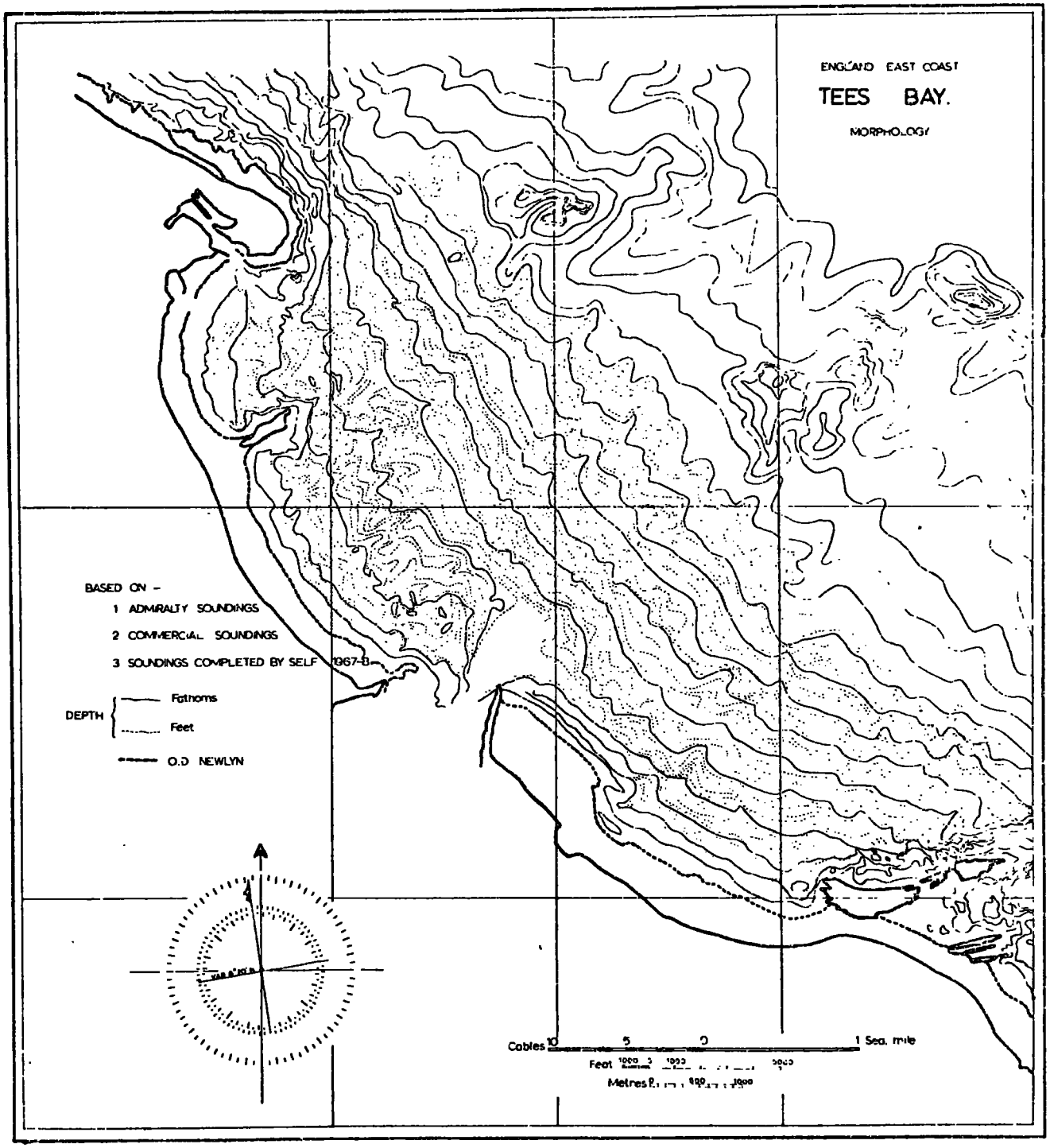

ENGLAND EAST COAST
TEES BAY.
MORPHOLOGY
BASED ON –
1 ADMIRALTY SOUNDINGS
2 COMMERCIAL SOUNDINGS
3 SOUNDINGS COMPLETED BY SELF 1967-8
DEPTH
Fathoms
Feet
O.D NEWLYN
Cables 10 5 0 1 Sea. mile
Feet
Metres

FIG. 27

SEABED PROFILES
THE LOWER TEES

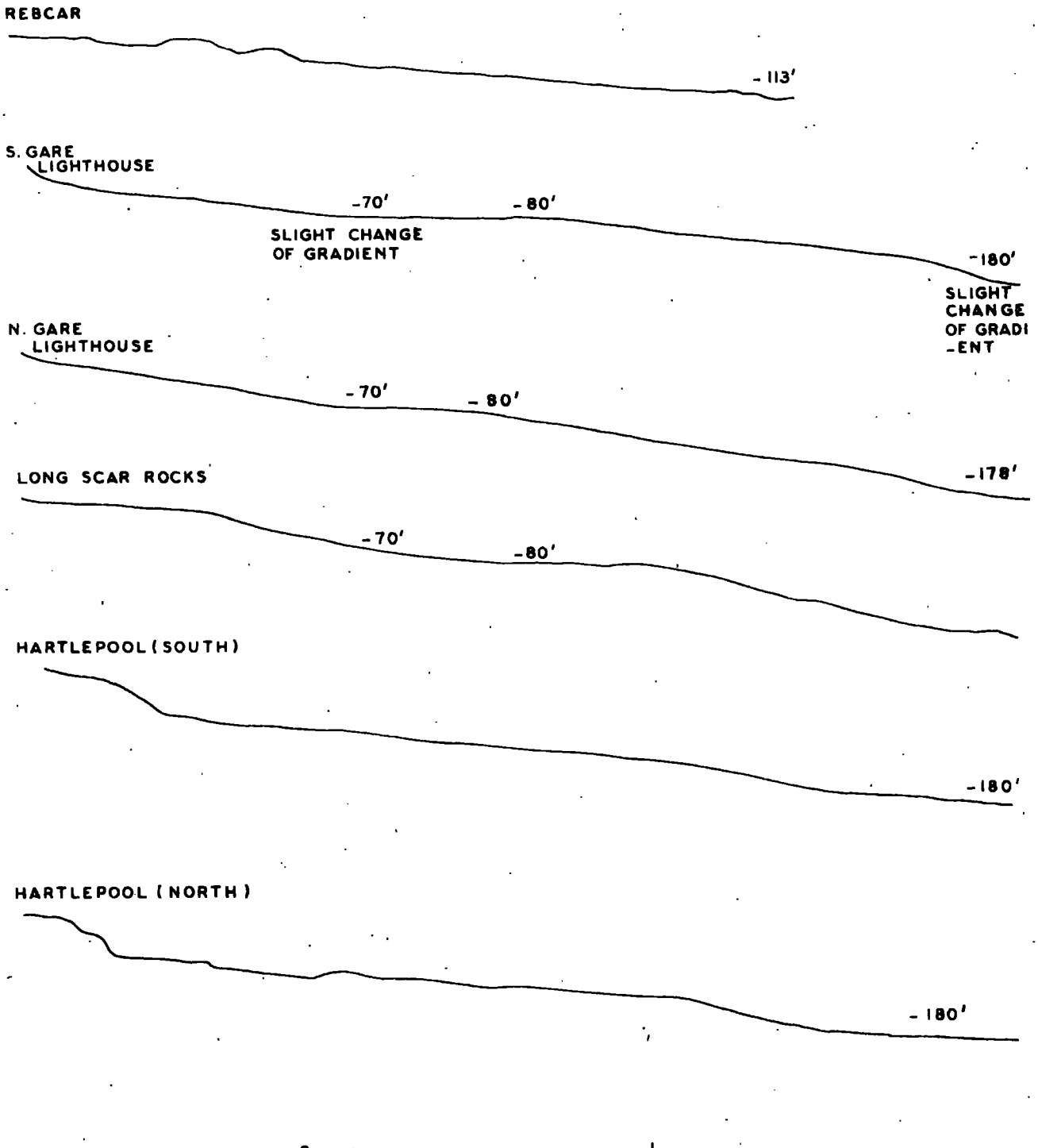


FIG. 28

SEABED CONTOUR PLAN OFF THE SUNDERLAND COAST

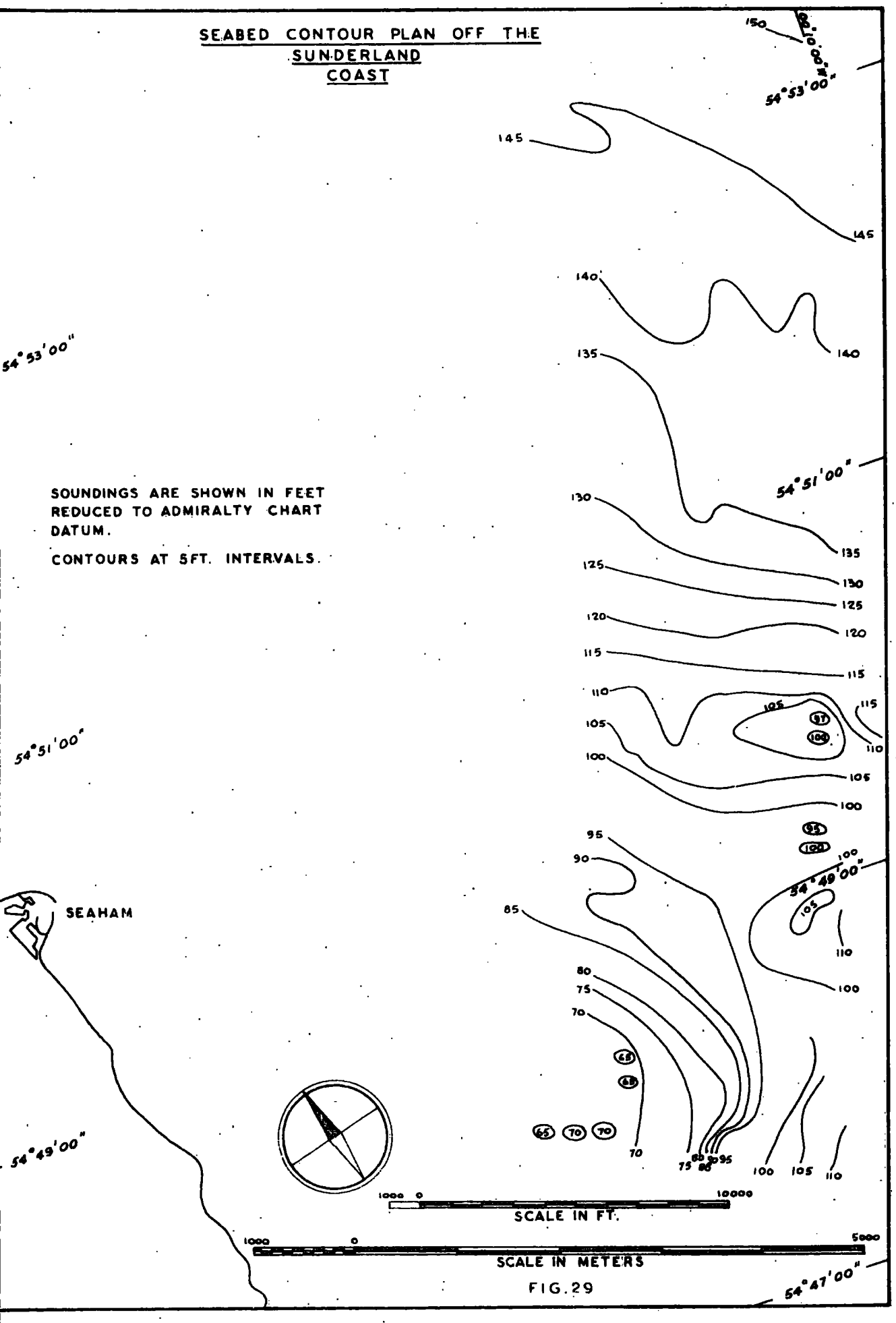


FIG.29

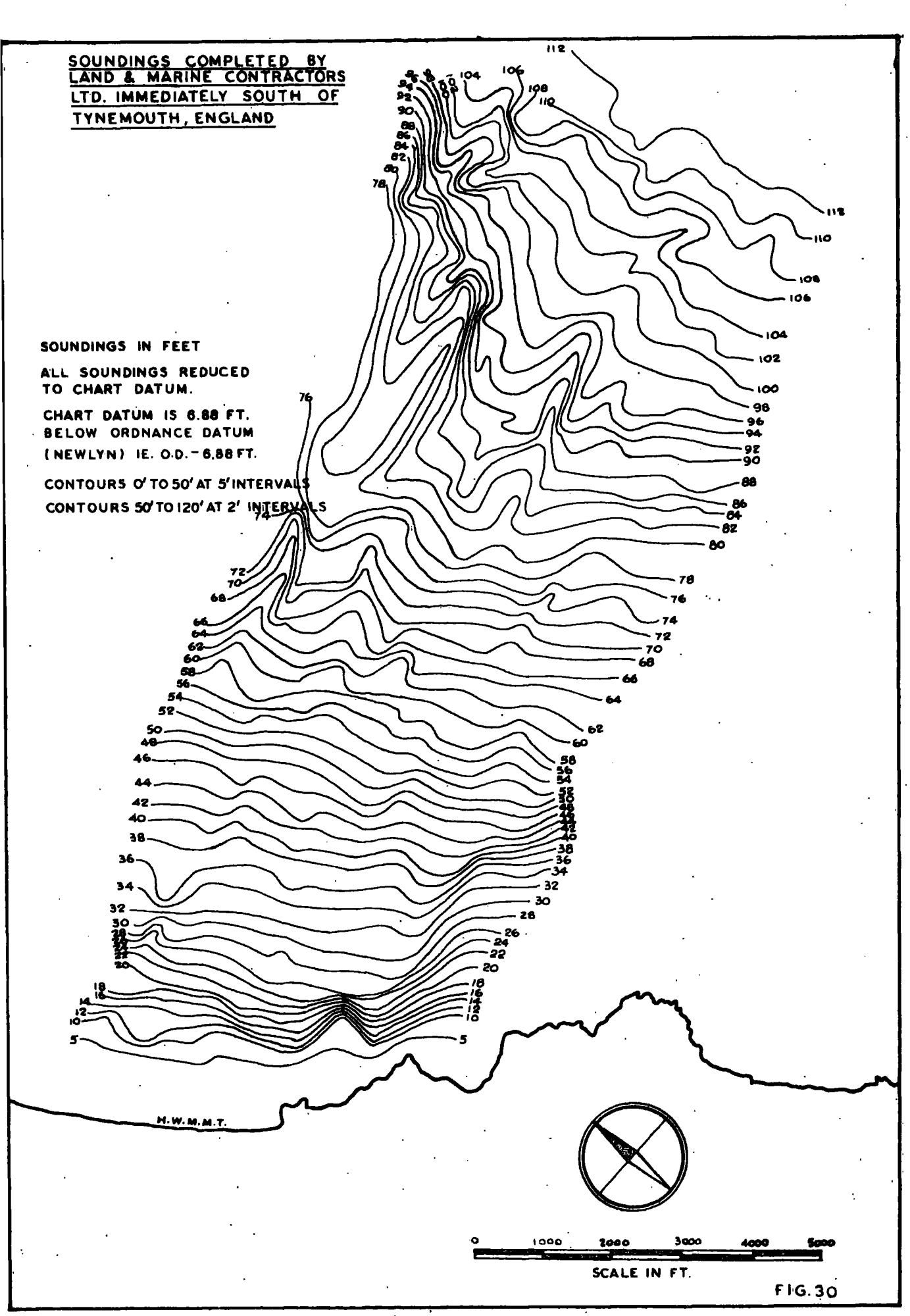

SOUNDINGS COMPLETED BY LAND & MARINE CONTRACTORS LTD. IMMEDIATELY SOUTH OF TYNEMOUTH, ENGLAND
SOUNDINGS IN FEET
ALL SOUNDINGS REDUCED TO CHART DATUM.
CHART DATUM IS 6.88 FT. BELOW ORDNANCE DATUM (NEWLYN) IE. O.D. - 6.88 FT.
CONTOURS 0' TO 50' AT 5' INTERVALS
CONTOURS 50' TO 120' AT 2' INTERVALS
H.W.M.M.T.
0 1000 2000 3000 4000 5000
SCALE IN FT.

FIG. 30

SOUNDINGS COMPLETED BY LAND & MARINE CONTRACTORS LTD. IMMEDIATELY NORTH OF WHITLEY BAY

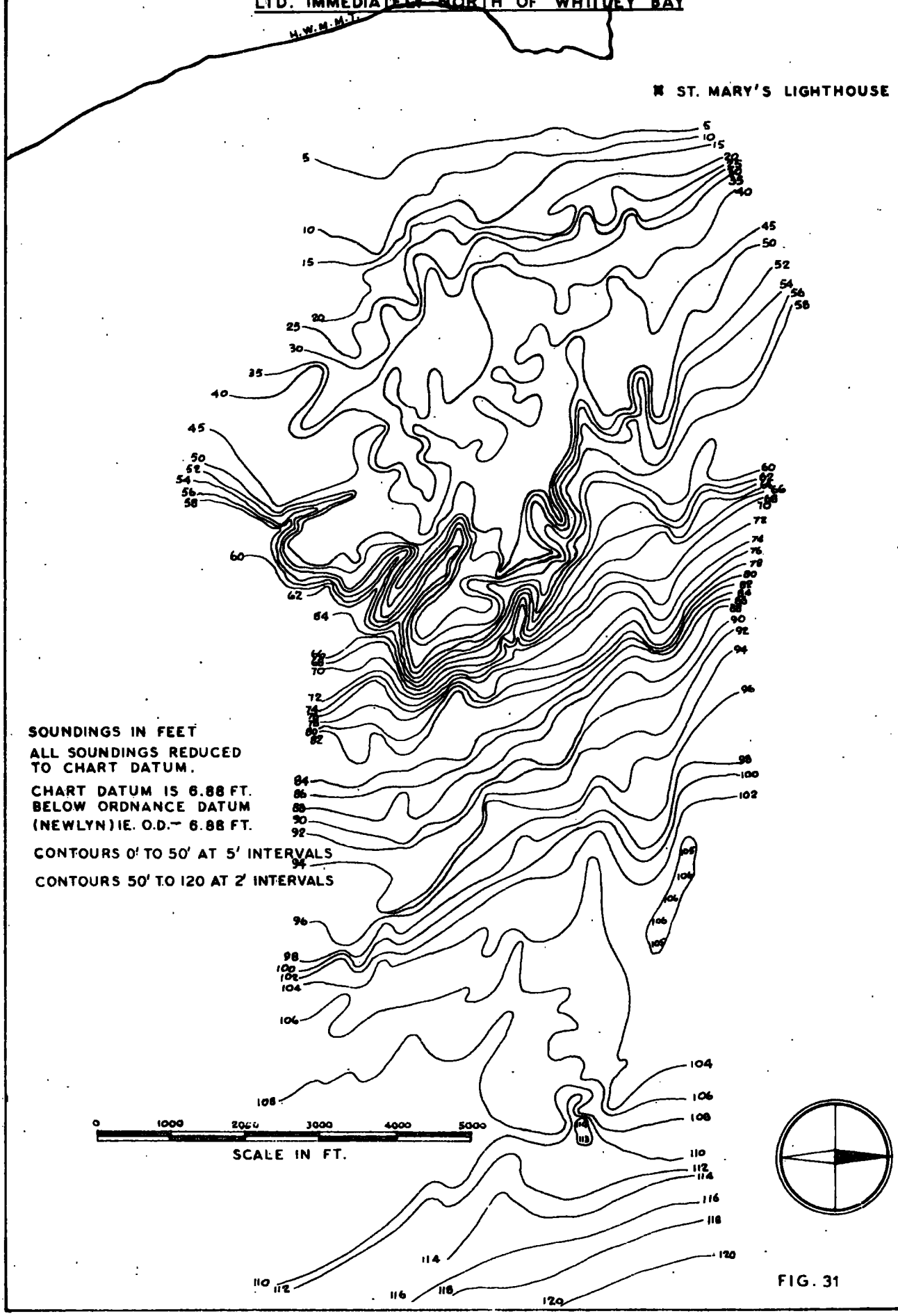


FIG. 31

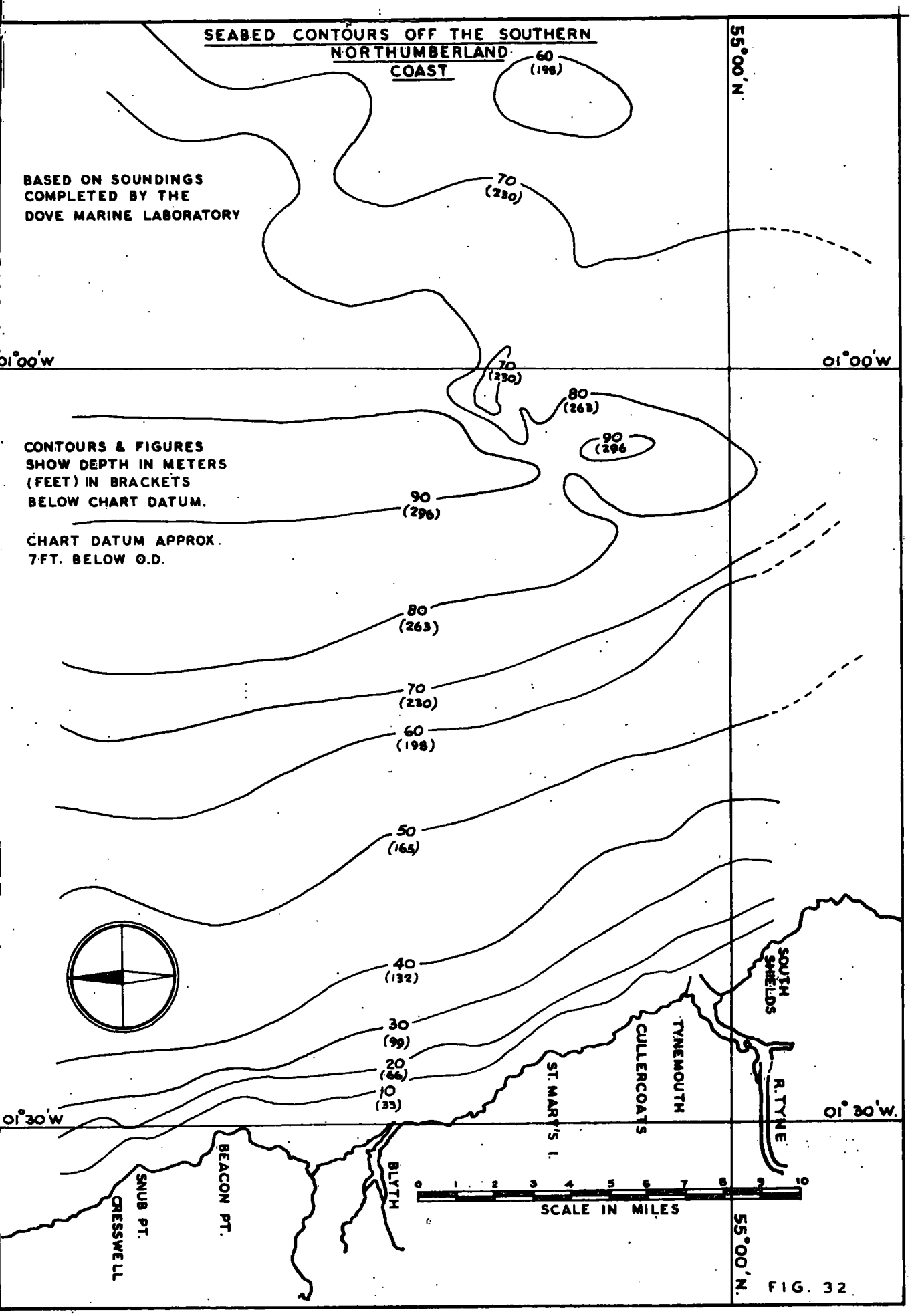

SEABED CONTOURS OFF THE SOUTHERN NORTHUMBERLAND COAST
BASED ON SOUNDINGS COMPLETED BY THE DOVE MARINE LABORATORY
CONTOURS & FIGURES SHOW DEPTH IN METERS (FEET) IN BRACKETS BELOW CHART DATUM.
CHART DATUM APPROX. 7 FT. BELOW O.D.
60 (198)
70 (230)
80 (263)
90 (296)
50 (165)
40 (132)
30 (99)
20 (66)
10 (33)
55°00'N.
01°00'W
01°30'W.
SOUTH SHIELDS
R. TYNE
TYNEMOUTH
CULLERCOATS
ST. MARY'S I.
BLYTH
BEACON PT.
SNUB PT.
CRESSWELL
0 1 2 3 4 5 6 7 8 9 10
SCALE IN MILES

FIG. 32

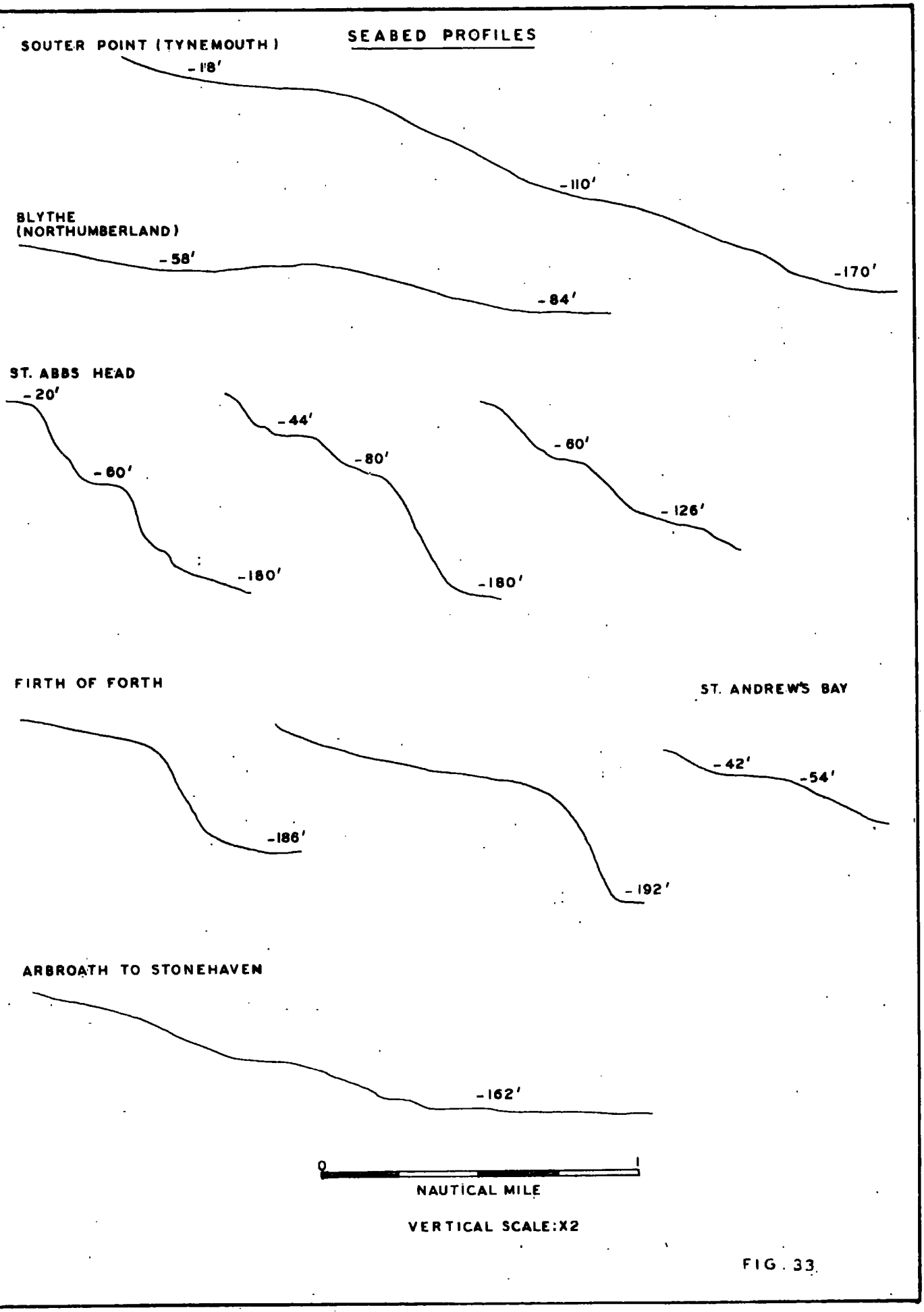

SEABED PROFILES
SOUTER POINT (TYNEMOUTH)
-18'
-110'
-170'
BLYTHE
(NORTHUMBERLAND)
-58'
-84'
ST. ABBS HEAD
-20'
-60'
-180'
-44'
-80'
-180'
-60'
-126'
FIRTH OF FORTH
-186'
-192'
ST. ANDREW'S BAY
-42'
-54'
ARBROATH TO STONEHAVEN
-162'
0
1
NAUTICAL MILE
VERTICAL SCALE: X2

FIG. 33

SCHEMATIC DIAGRAM OF SPARKER SURVEY
AND EQUIPMENT

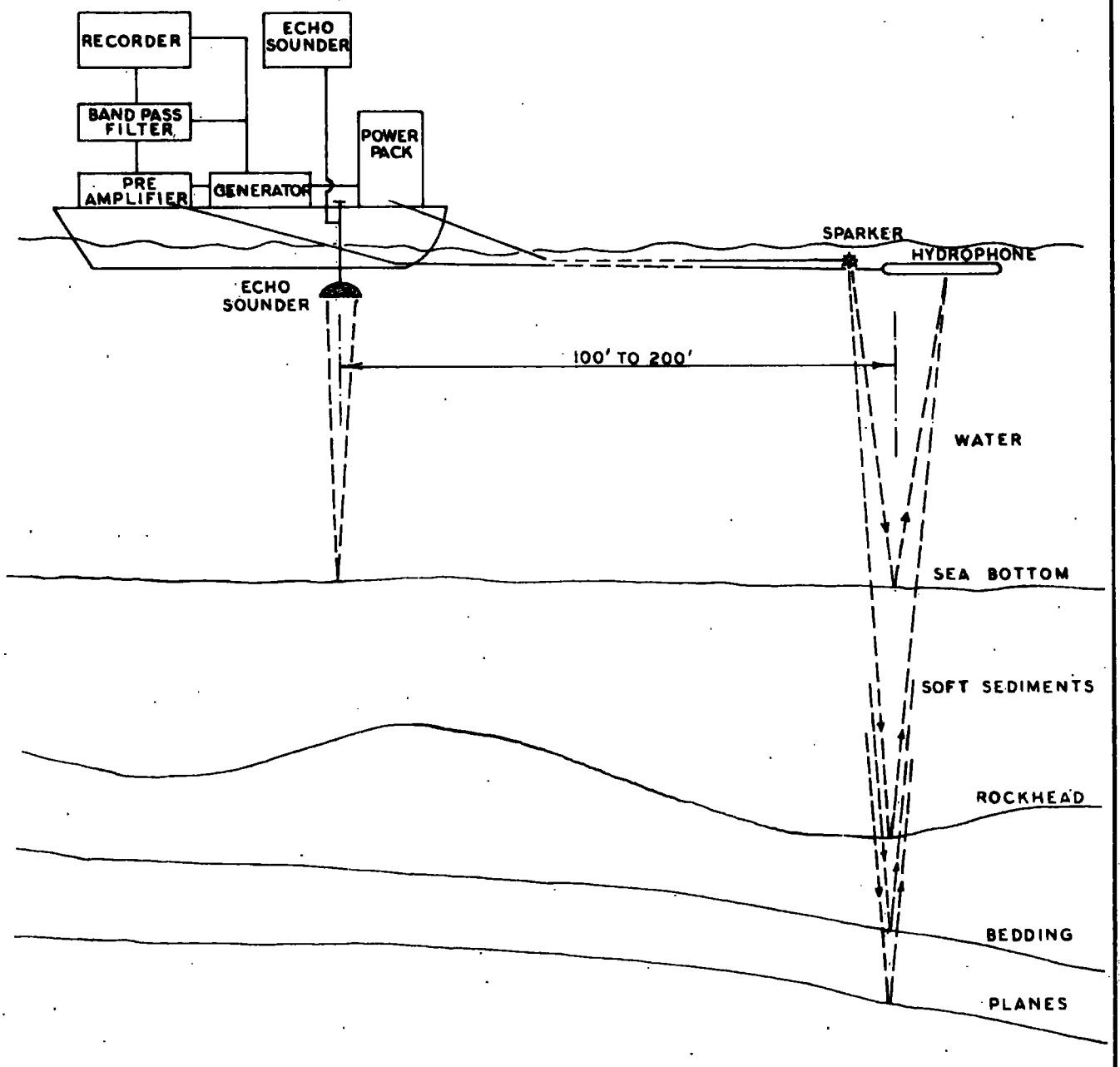
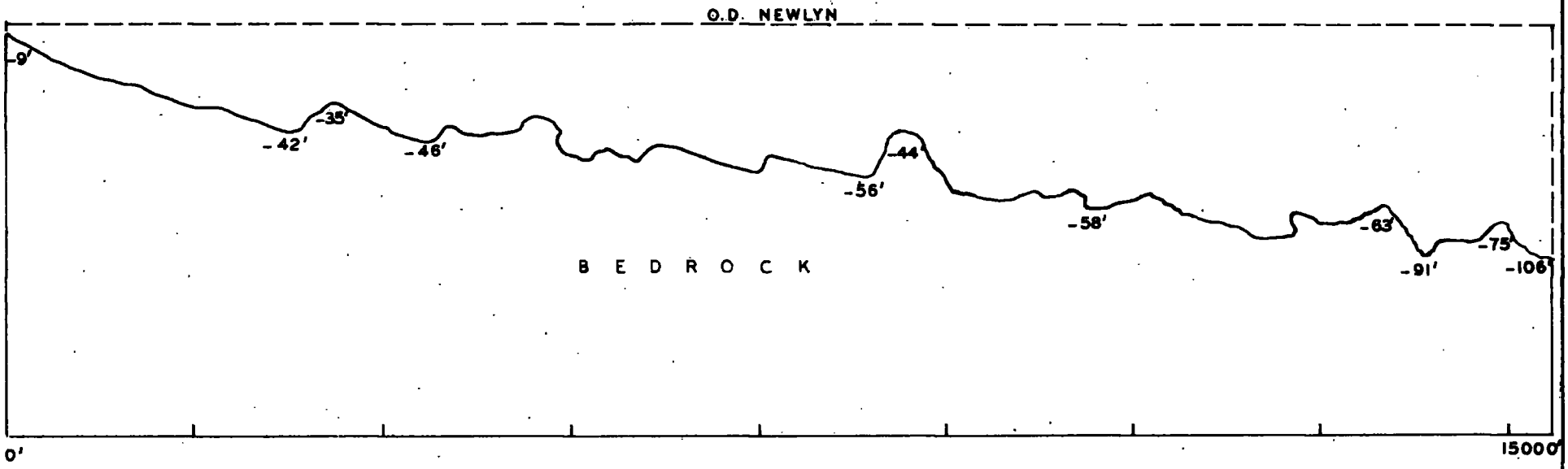


FIG. 34.

PROFILE 1

E.N.E FROM POINT ON SHORE MIDWAY BETWEEN MARSKE AND REDCAR



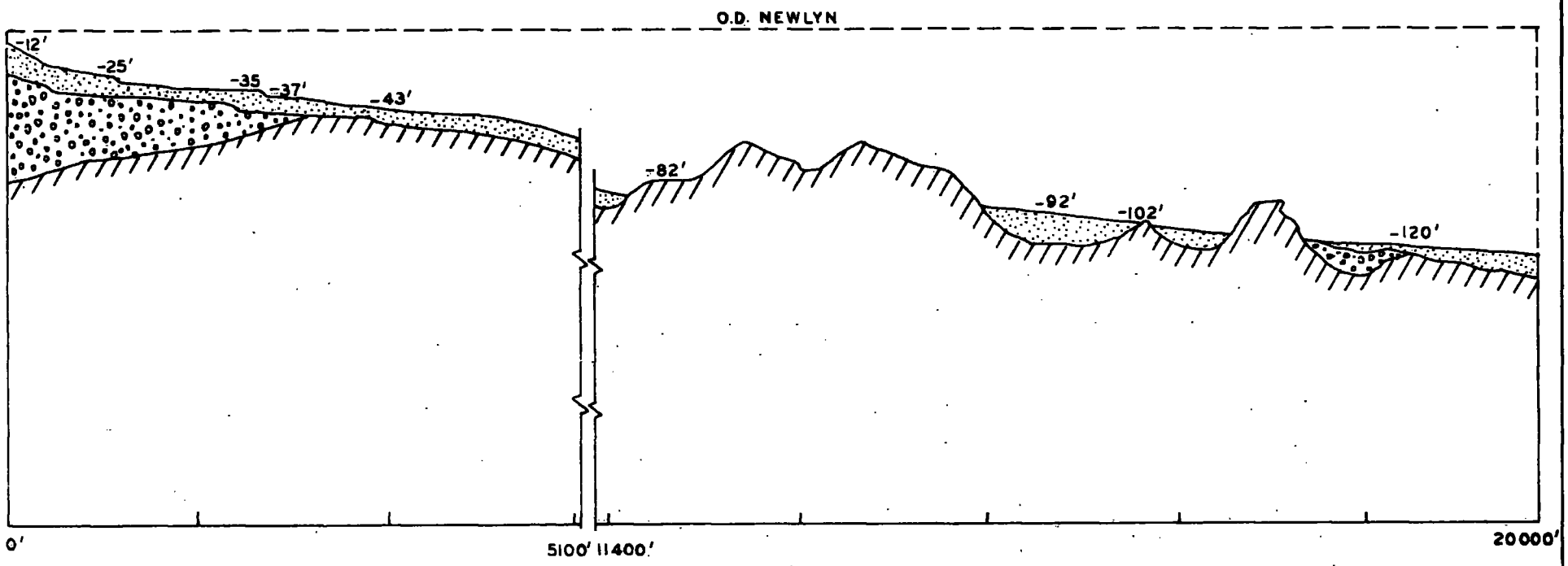
HORIZONTAL SCALE : 1" = 1700'
VERTICAL SCALE : 1" = 170'
VERTICAL EXAGGERATION: X 10

NOTE: PROFILE SHOWS ONLY BEDROCK

FIG. 35

PROFILE 2

E.N.E. FROM POINT MIDWAY BETWEEN WEST SCAR ROCKS & OFF THE SOUTH GARE LIGHTHOUSE



HORIZONTAL SCALE: 1" = 1700'

VERTICAL SCALE: 1" = 170'

VERTICAL EXAGGERATION: X10

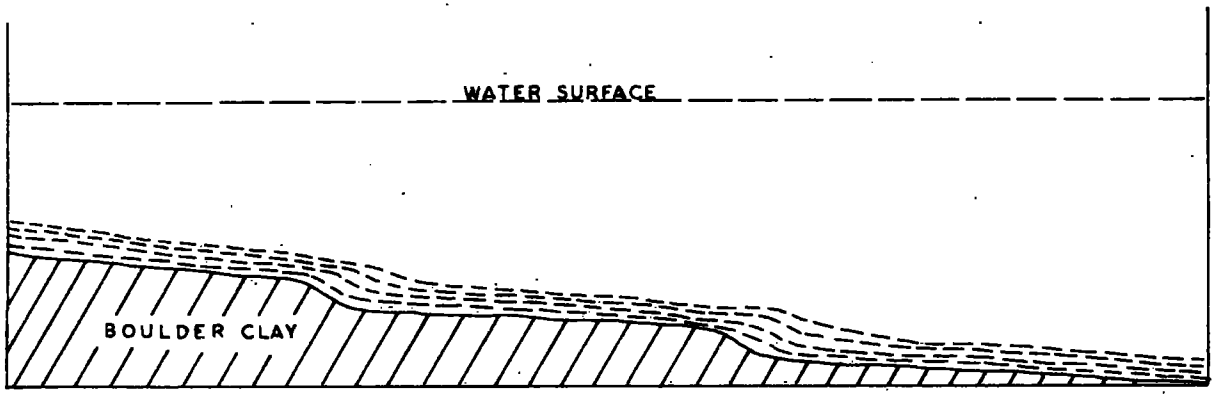
SAND

BOULDER CLAY

BEDROCK

FIG. 36

EXPERIMENT ILLUSTRATING THE POSSIBLE RELATIONSHIP BETWEEN SEABED FORMS AND THE SURFACE OF THE UNDERLYING BOULDER CLAY.

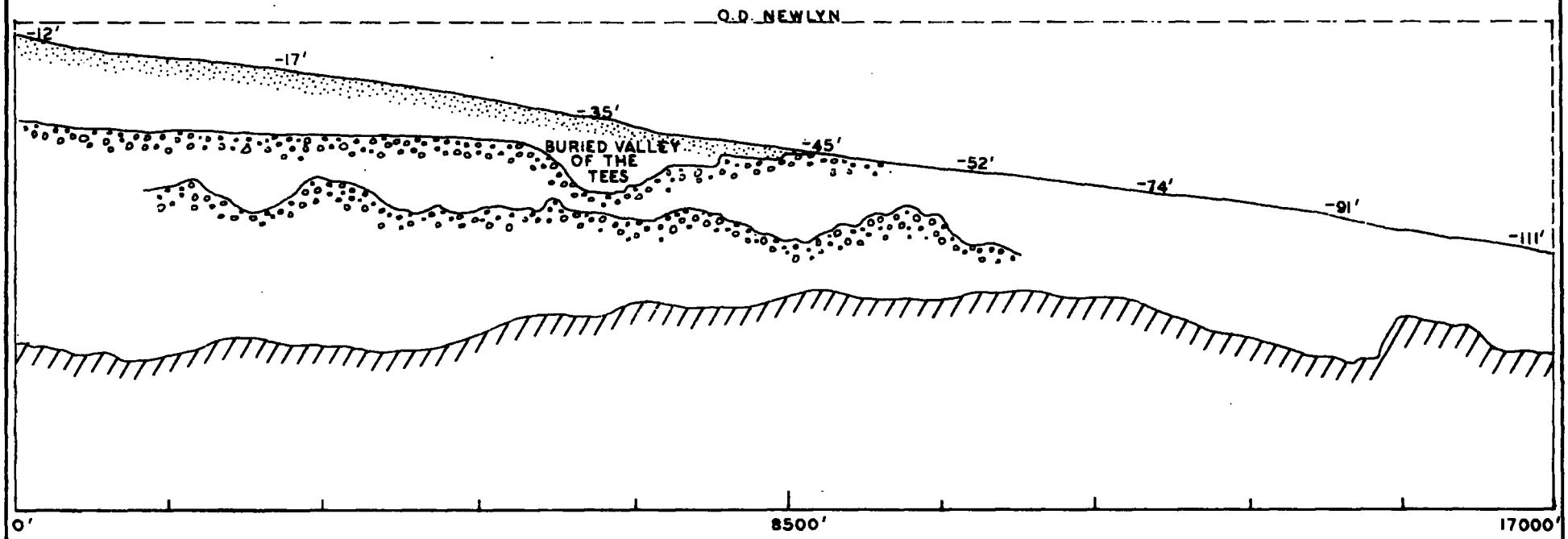


NOTE HOW THE SETTLED LAYERS HAVE THE EFFECT
OF MOVING THE BREAK OF SLOPE TOWARD DEEPER WATER

FIG. 37

PROFILE 3

E N.E FROM POINT ONE MILE SOUTH OF THE SOUTH GARE LIGHTHOUSE



HORIZONTAL SCALE 1" = 1700'

VERTICAL SCALE : 1" = 170'

VERTICAL EXAGGERATION : X10

SAND

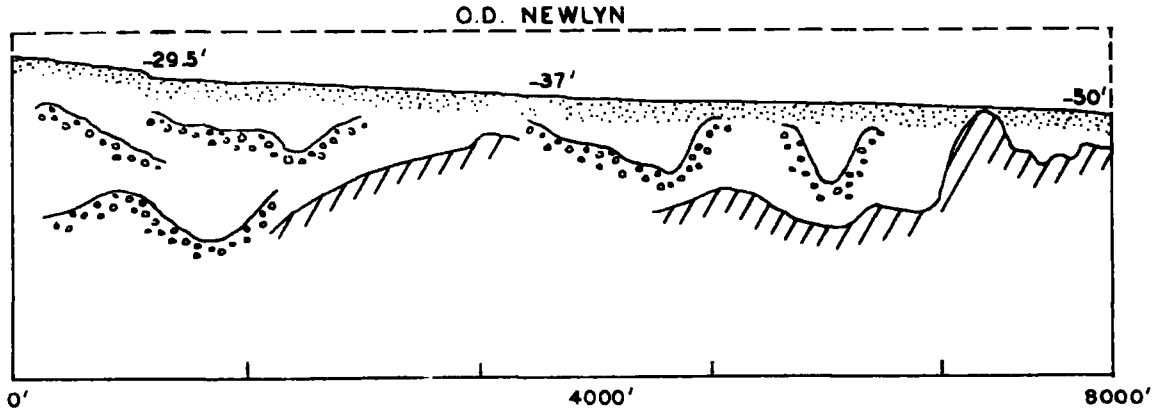
BOULDER CLAY

BEDROCK

FIG 38

PROFILE 4

N.N.E. FROM NORTH GARE LIGHTHOUSE

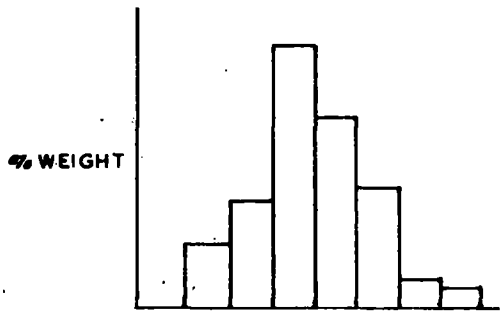


HORIZONTAL SCALE: 1" = 1700'
VERTICAL SCALE. 1" = 170'
VERTICAL EXAGGERATION: X10

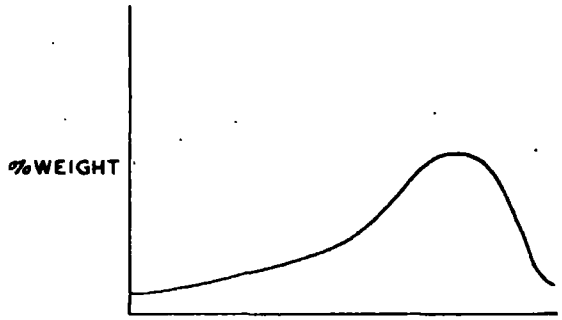
SAND
BOULDER CLAY
BEDROCK

FIG. 39

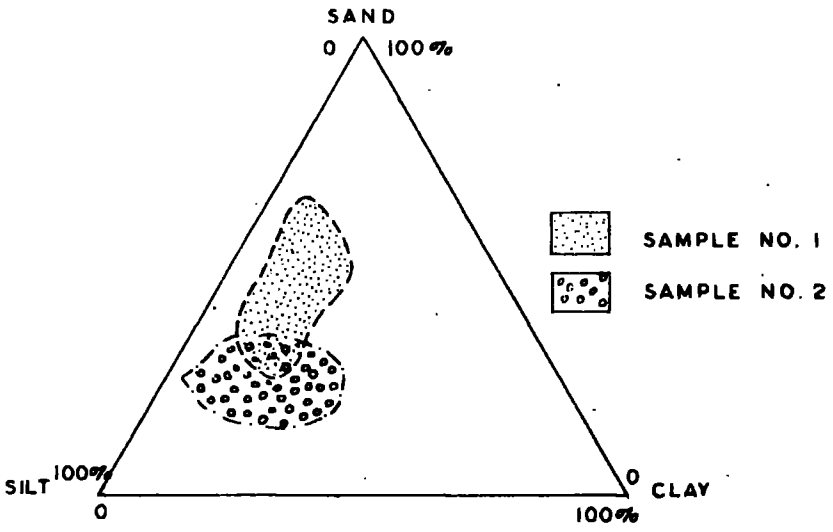
GRAPHICAL METHODS OF PRESENTATION OF PARTICLE SIZE ANALYSES

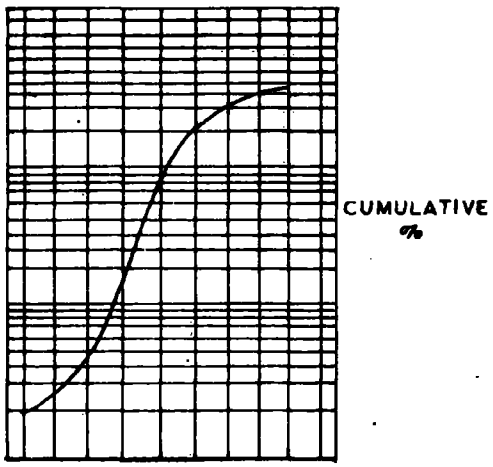


HISTOGRAM

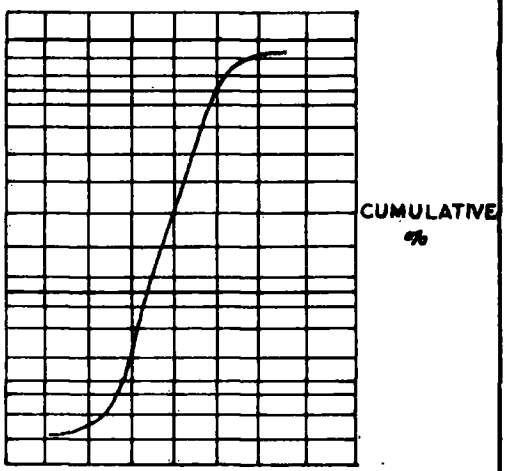


ARITHMETIC GRAPH





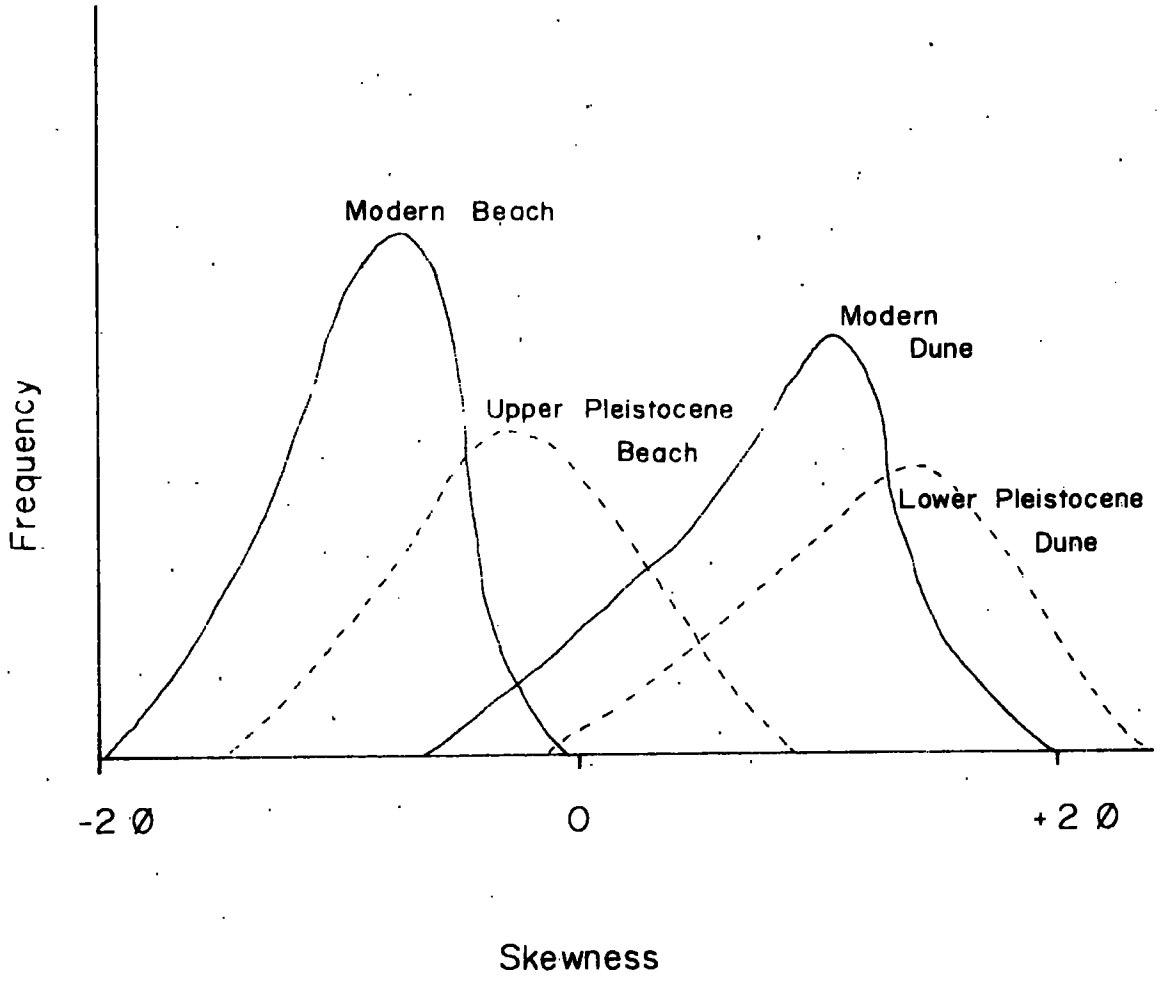
SEMI - LOG



ARITHMETIC PROBABILITY

FIG. 40.

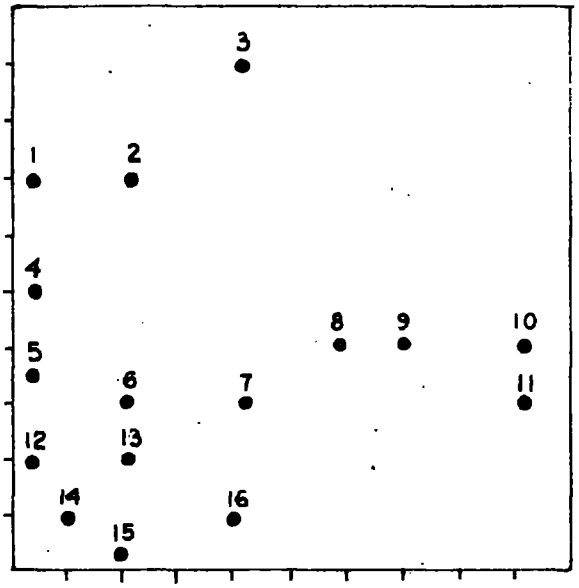
THE SEPARATION OF BEACH AND DUNE SANDS USING FRIEDMAN'S MEASURE OF SKEW



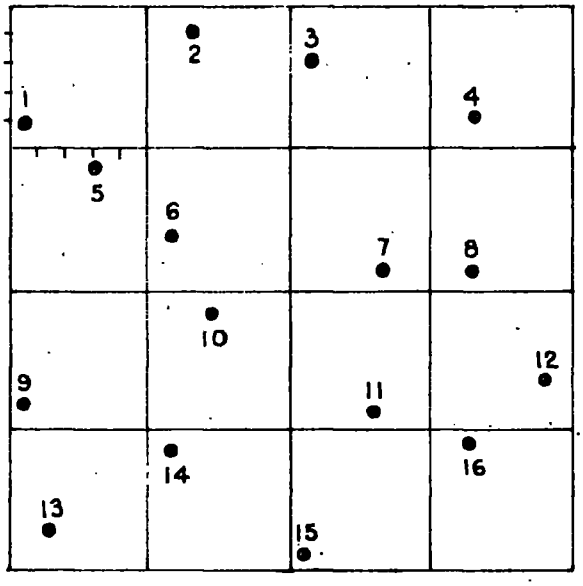
After Chappell 1967

FIG. 41

SAMPLING DIAGRAMS
ILLINOIS BEACH EXPERIMENT

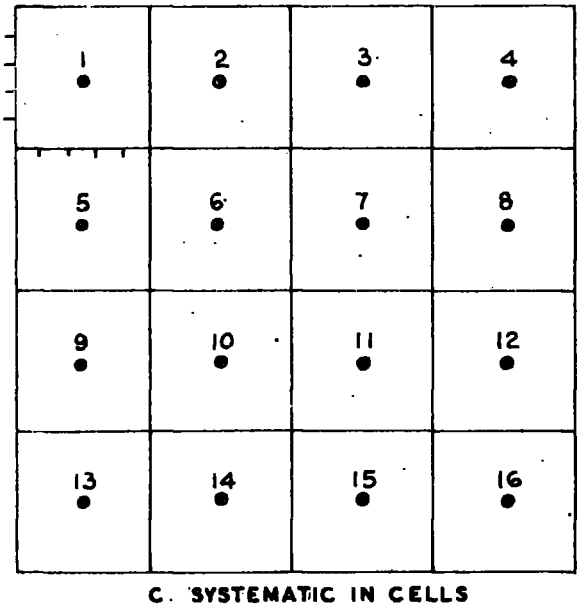


A. SIMPLE RANDOM SAMPLES

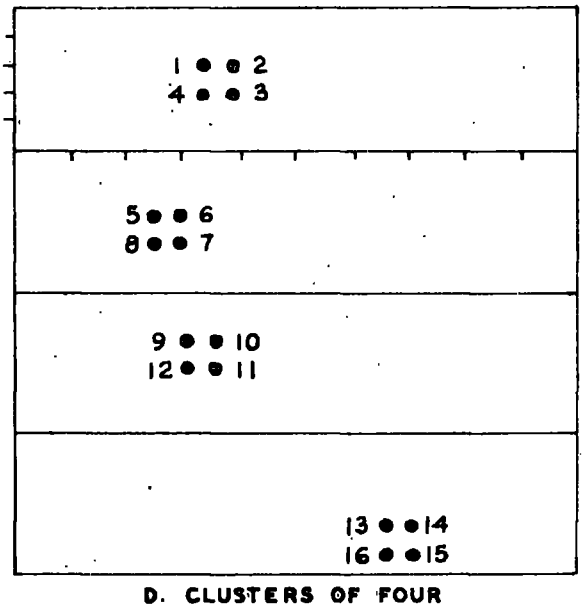


B. RANDOM IN CELLS

N



C. SYSTEMATIC IN CELLS

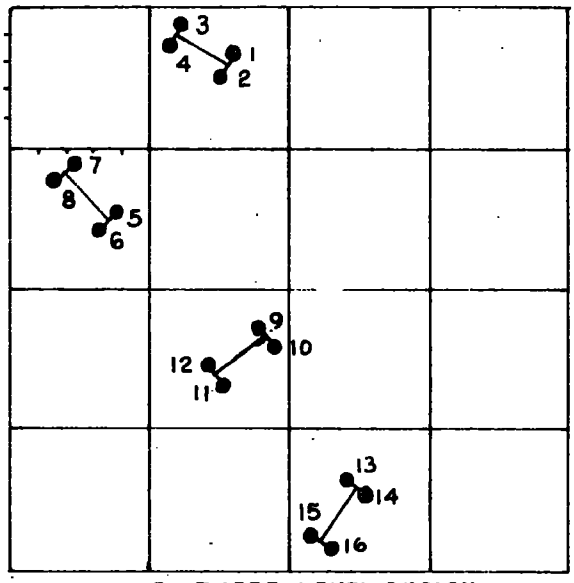


D. CLUSTERS OF FOUR

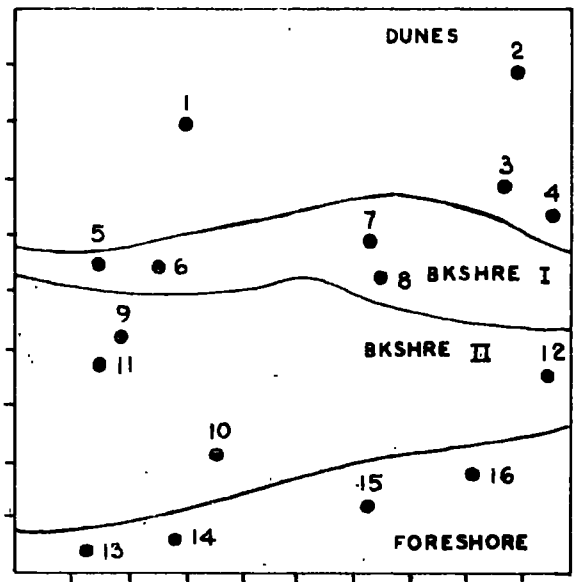
AFTER KRUMBEIN & SLACK

FIG. 42

SAMPLING DIAGRAMS
ILLINOIS BEACH EXPERIMENT

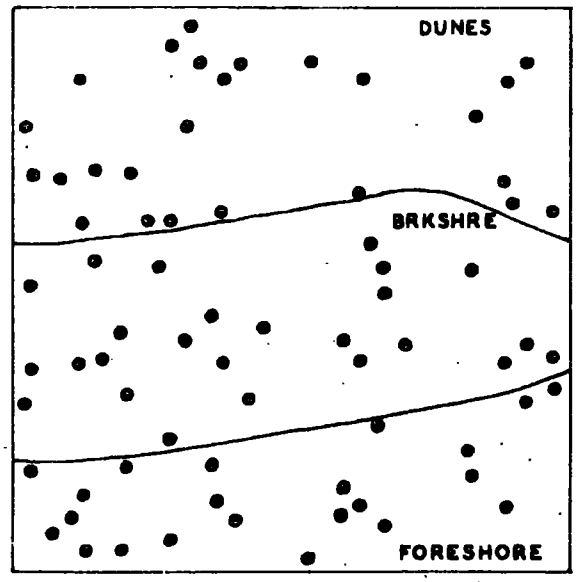


E. THREE LEVEL DESIGN

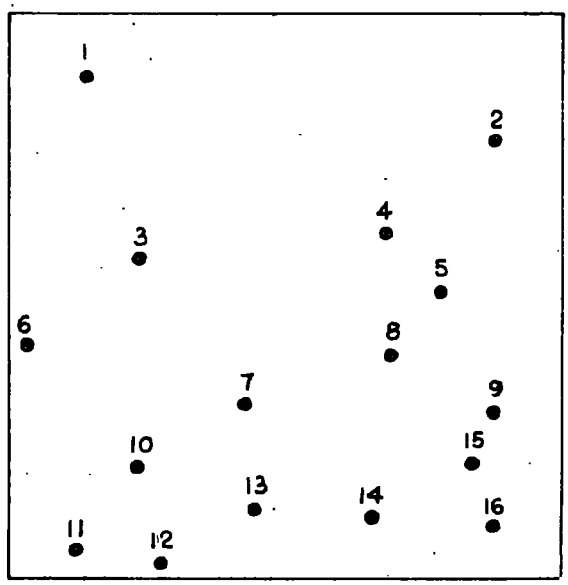


F. STRATIFIED RANDOM

N



G. THREE STRATA (COMBINED SAMPLES)

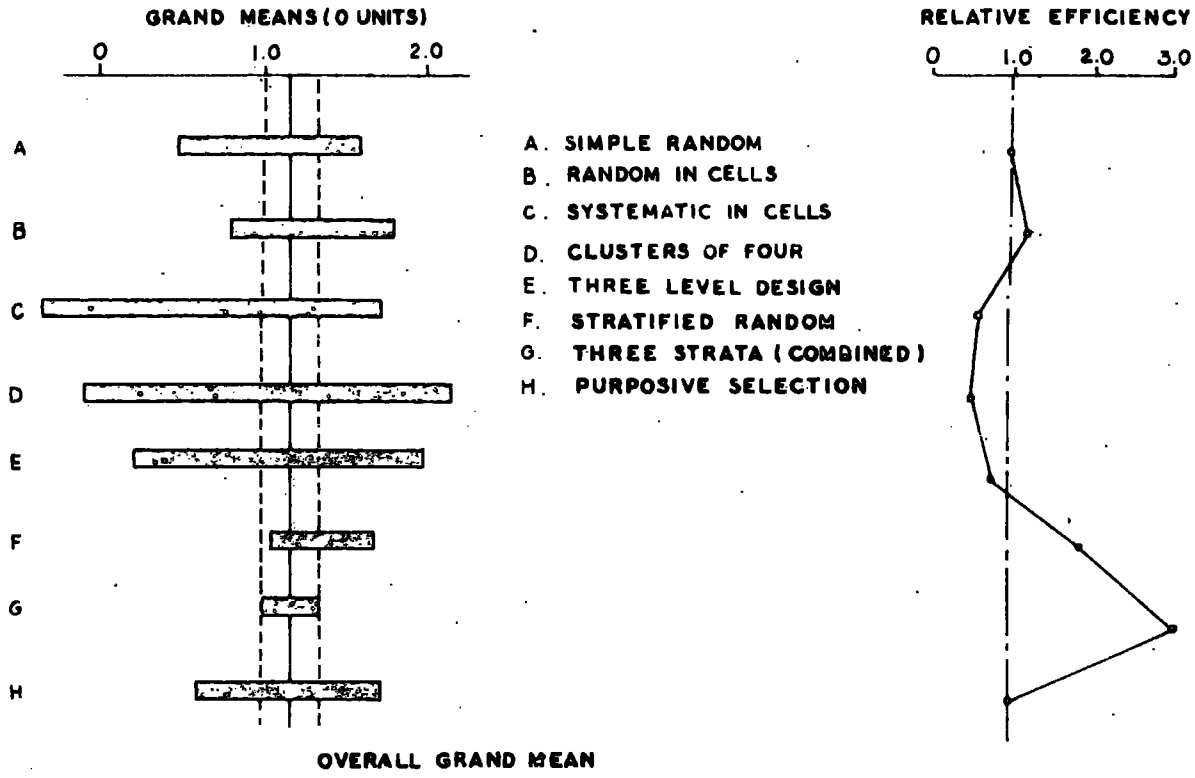


H. PURPOSIVE SELECTION

AFTER KRUMBEIN & SLACK

FIG. 43

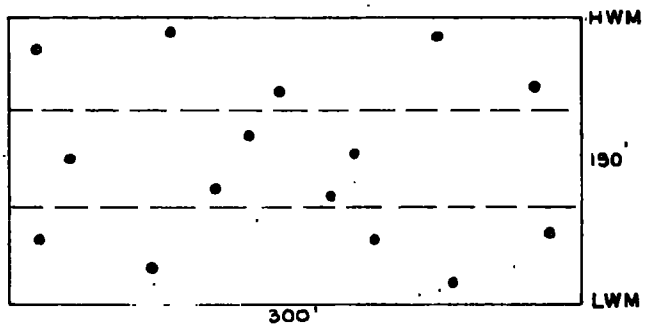
CONFIDENCE BANDS AND RELATIVE EFFICIENCY OF SAMPLING DESIGNS FOR PHI MEAN PARTICLE DIAMETERS.



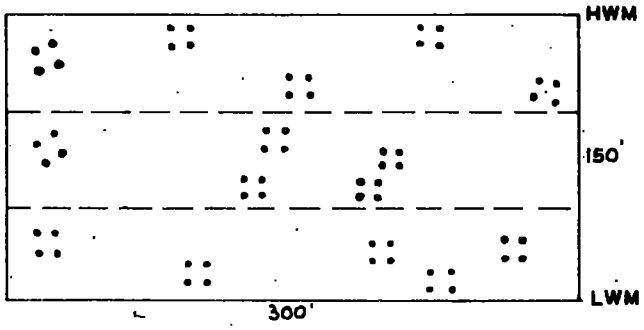
AFTER KRUMBEIN & SLACK

FIG. 44.

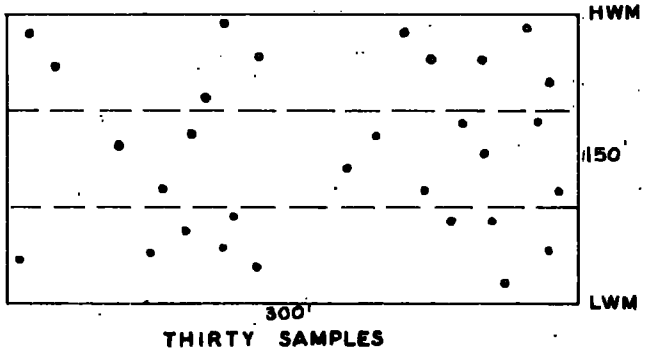
STRATIFIED RANDOM SAMPLES ON THE PRESENT DAY BEACH AT REDCAR



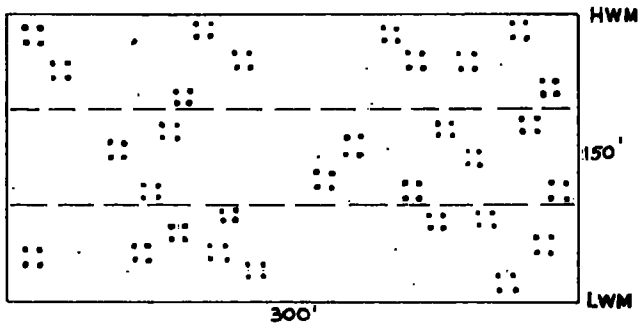
FIFTEEN SAMPLES



CLUSTER SAMPLING AT EACH OF THE FIFTEEN SAMPLE PTS.



THIRTY SAMPLES



CLUSTER SAMPLING AT EACH OF THE THIRTY SAMPLE PTS.

FIG. 4.5

MEAN CURVES OF SAND SIZE FRACTIONS

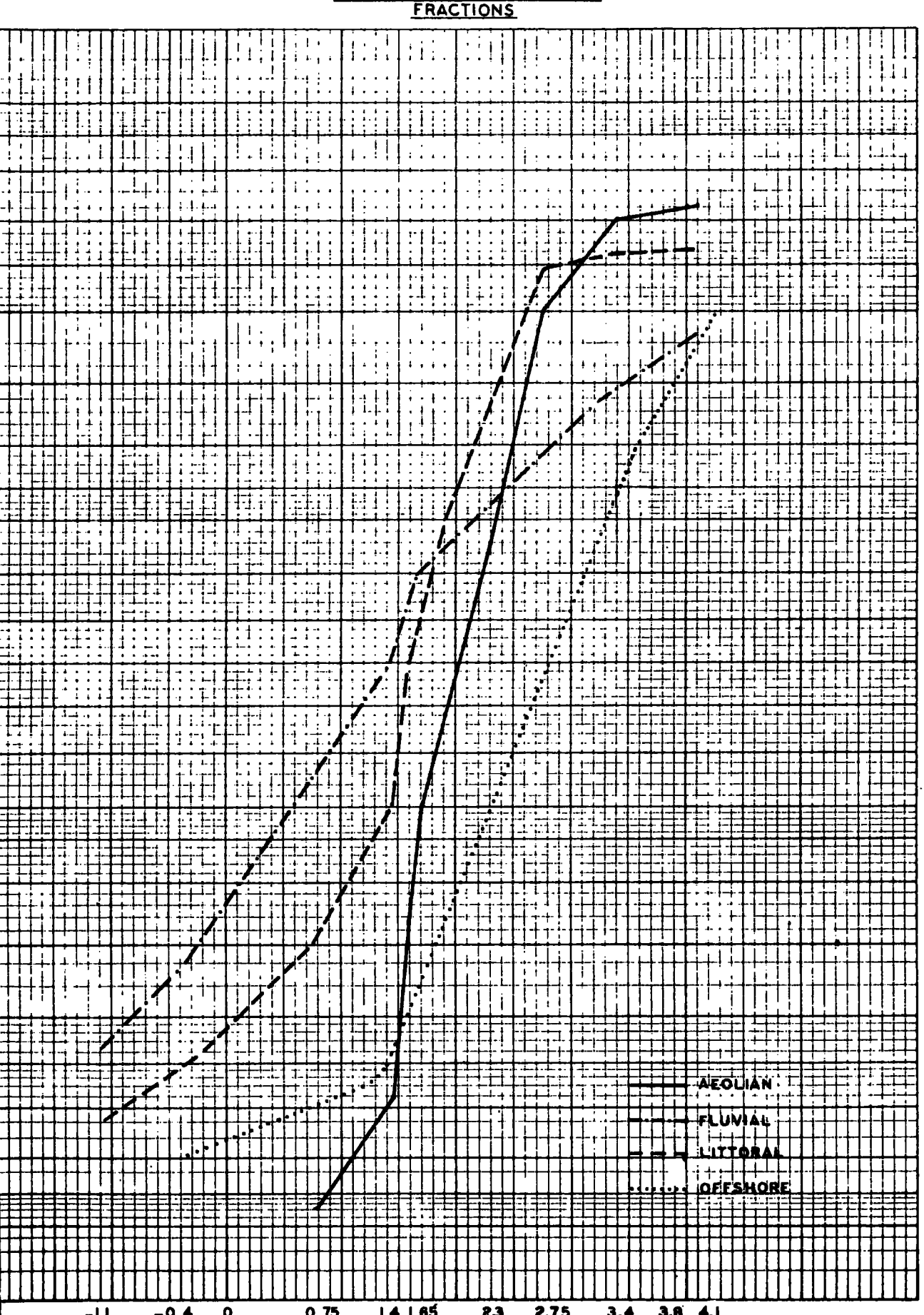
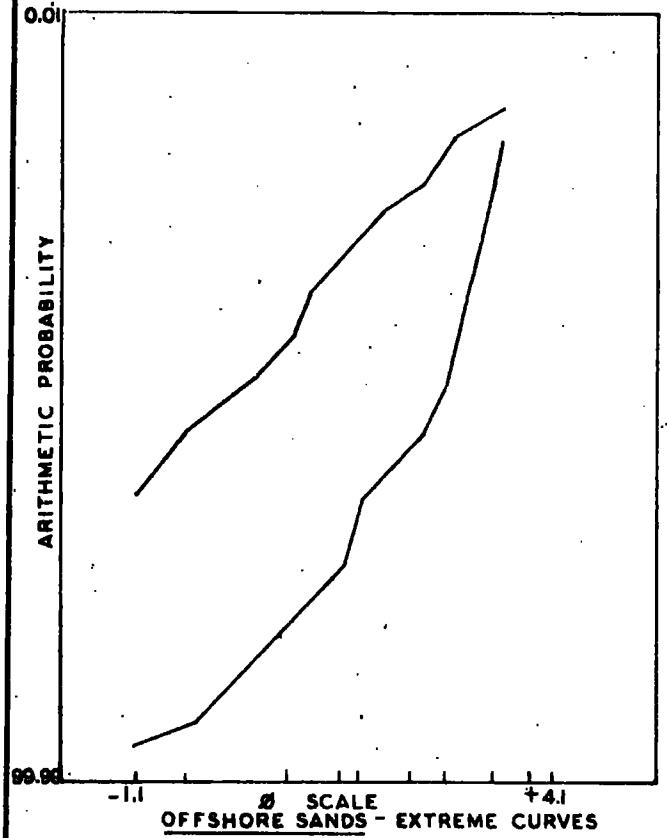
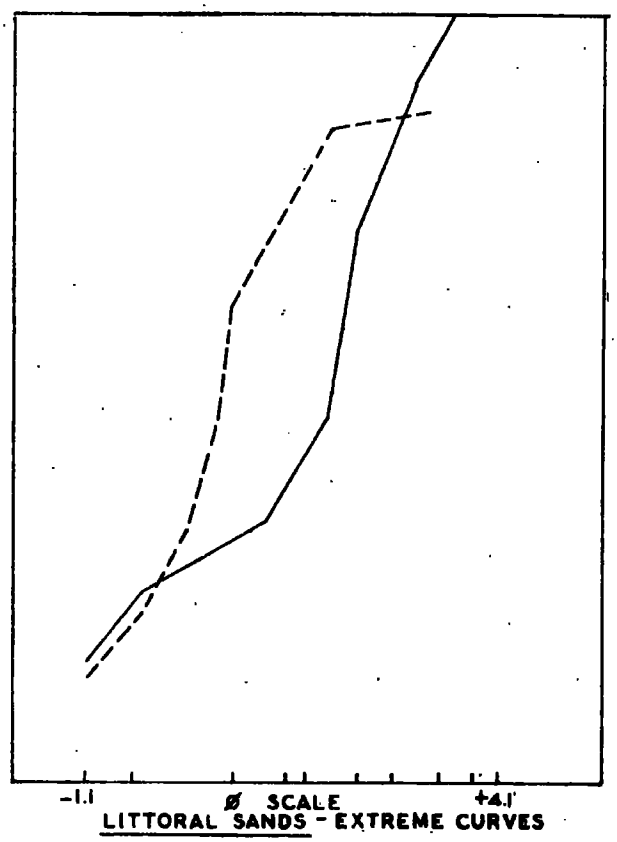


FIG. 46

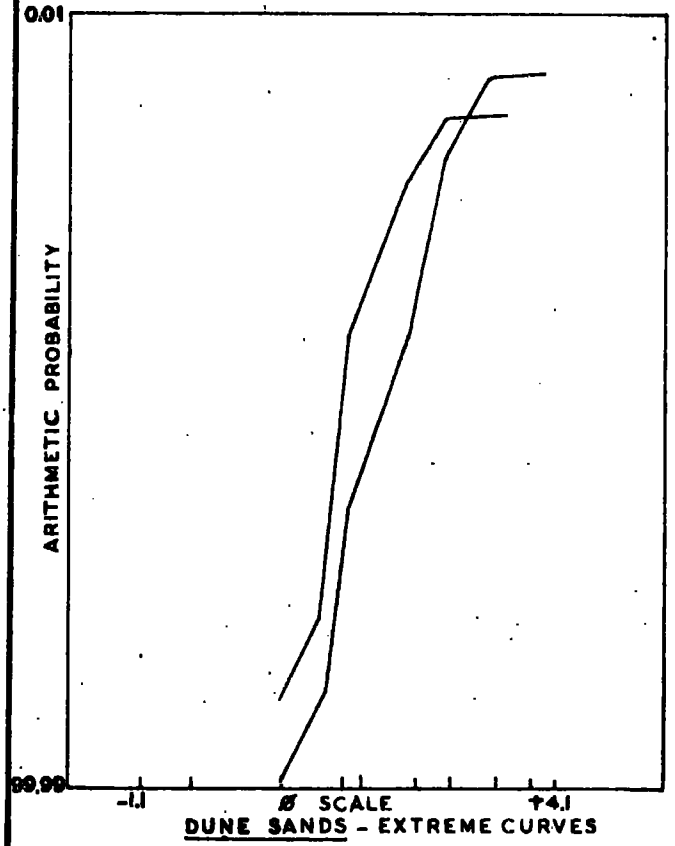
MAXIMUM VARIATIONS EXHIBITED BY PARTICLE SIZE CURVES



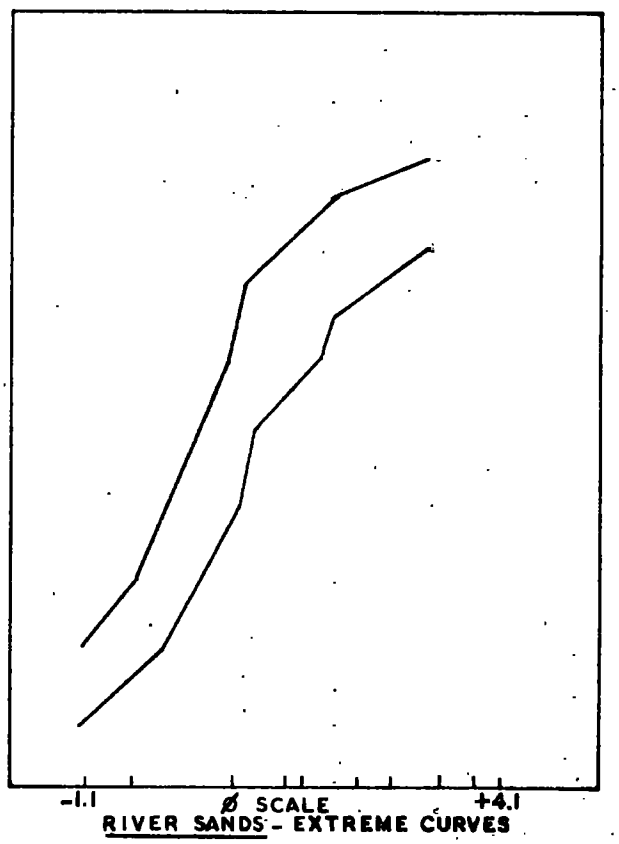
OFFSHORE SANDS - EXTREME CURVES



LITTORAL SANDS - EXTREME CURVES



DUNE SANDS - EXTREME CURVES



RIVER SANDS - EXTREME CURVES

FIG. 47

THORPE THEWLES BECK

THE EFFECTS OF CHANGING CONDITION ON PARTICLE SIZE

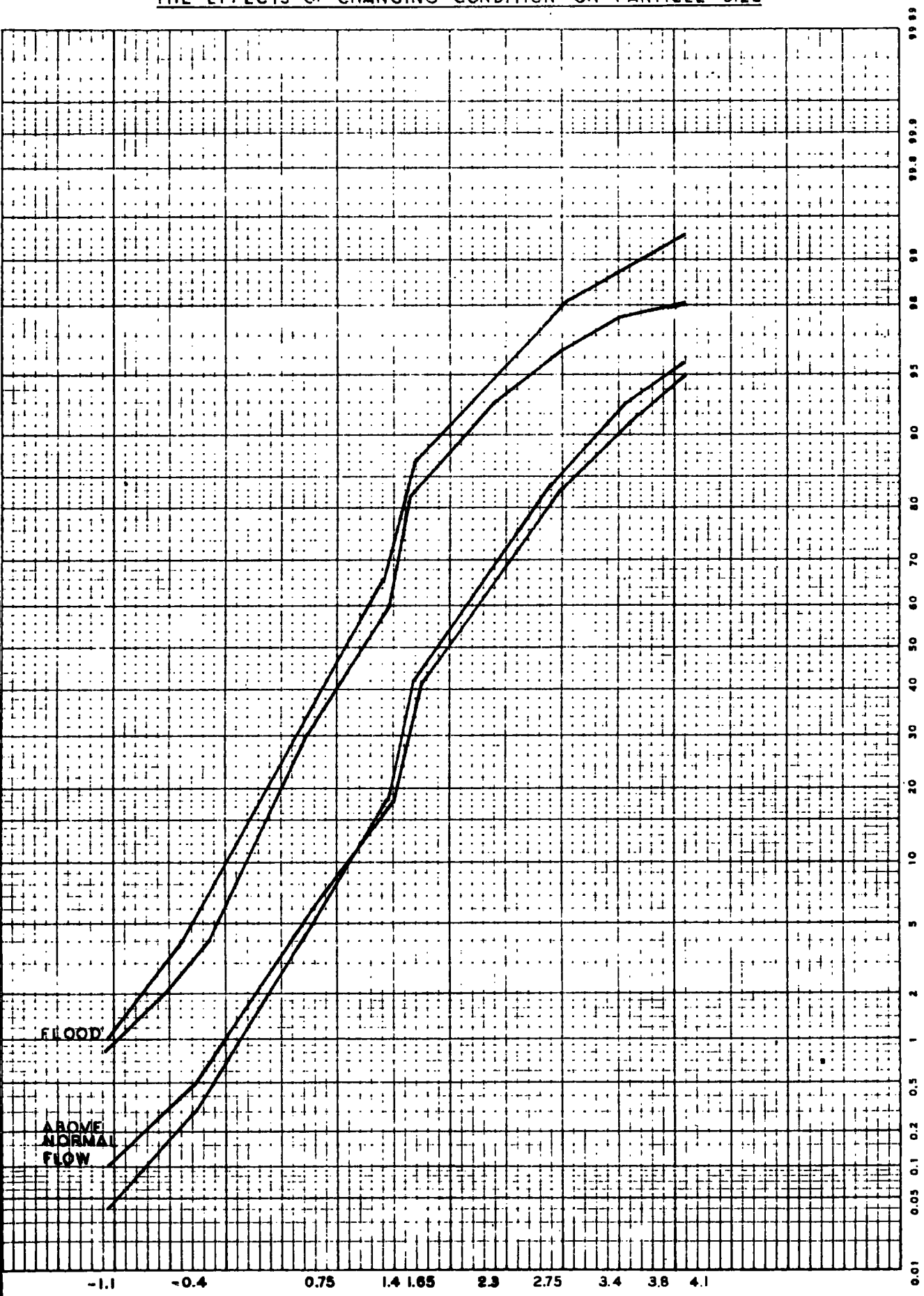


FIG. 48

THE LOCATION OF BEACH SAMPLE AREAS
IN THE TEES BASIN

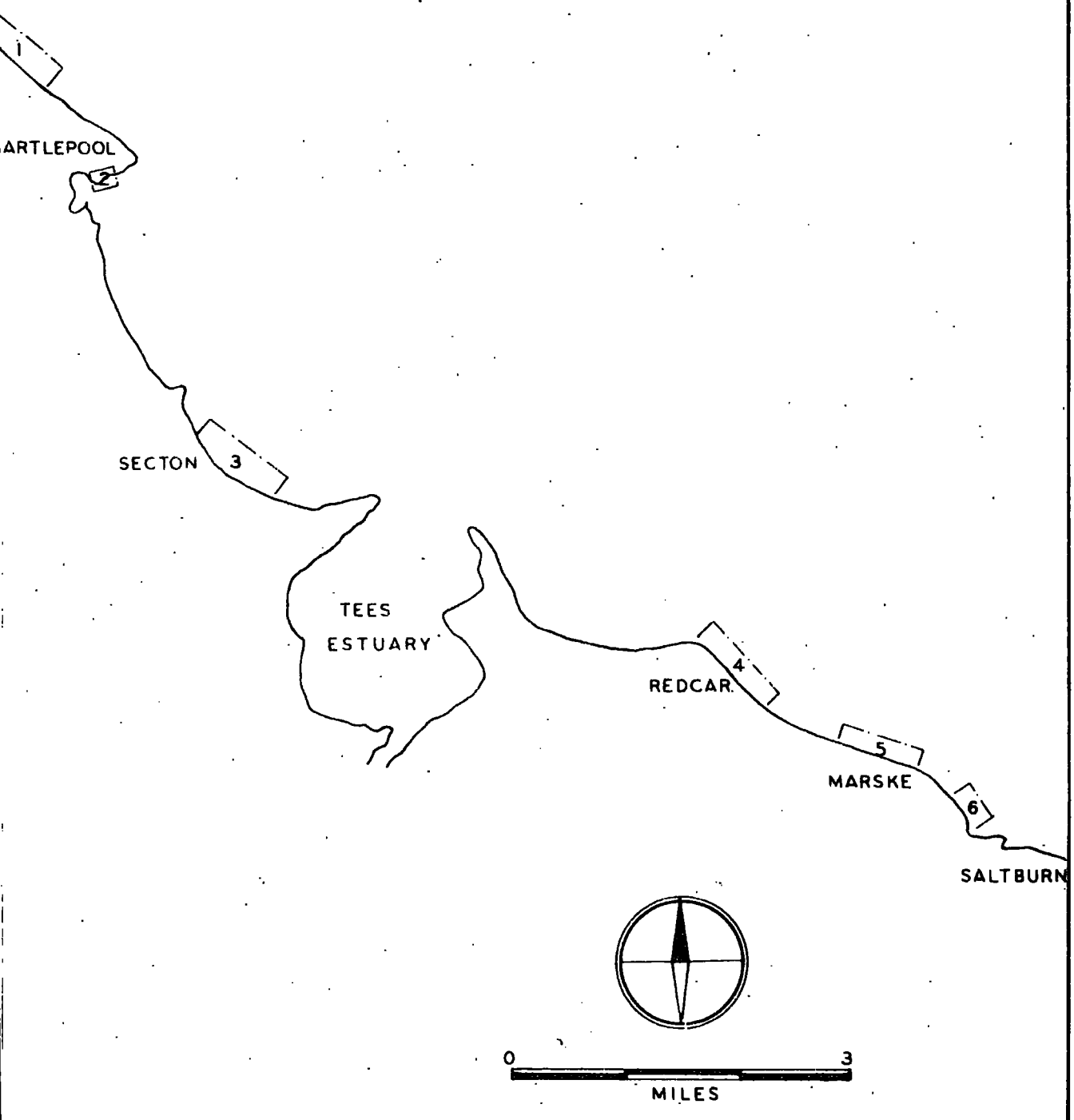
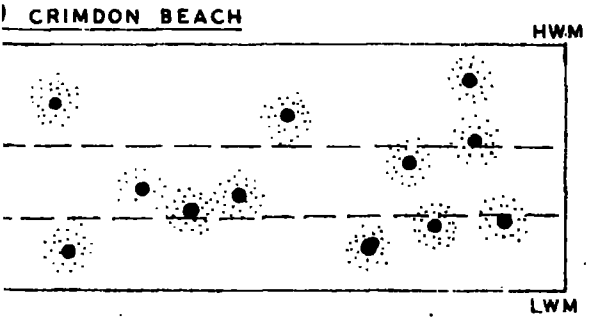


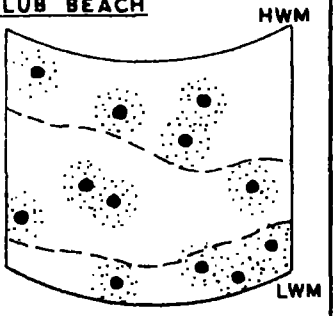
FIG. 49

SAMPLE LOCATIONS FOR EACH BEACH AREA

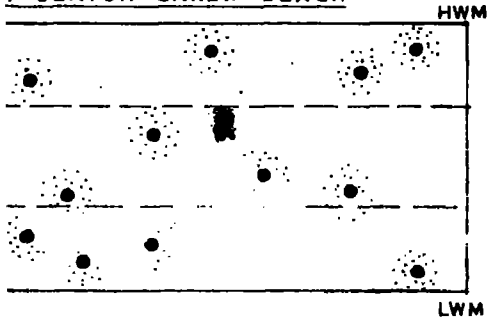
) CRIMDON BEACH



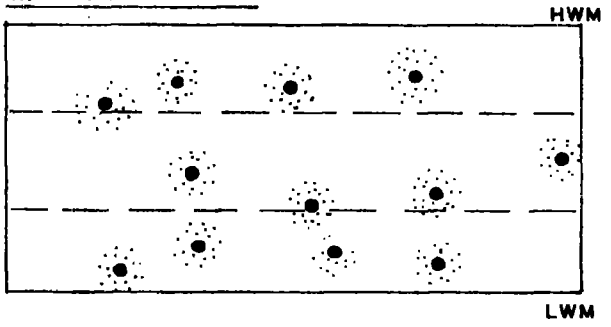
2.) HARTLEPOOL YACHT CLUB BEACH



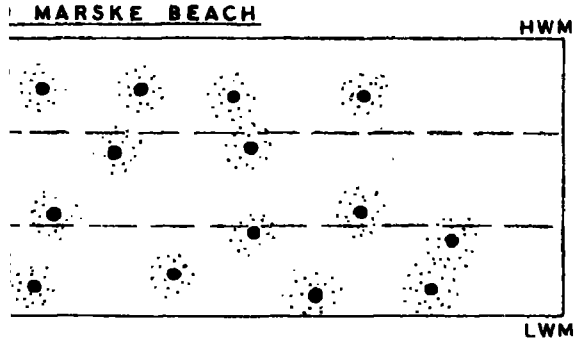
) SEATON CAREW BEACH



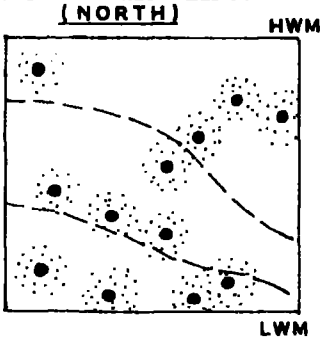
4.) REDCAR BEACH



MARSKE BEACH



6.) SALTBURN BEACH (NORTH)



SCALE: 1" = 100'

FIG. 50

CRIMDON BEACH
SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS

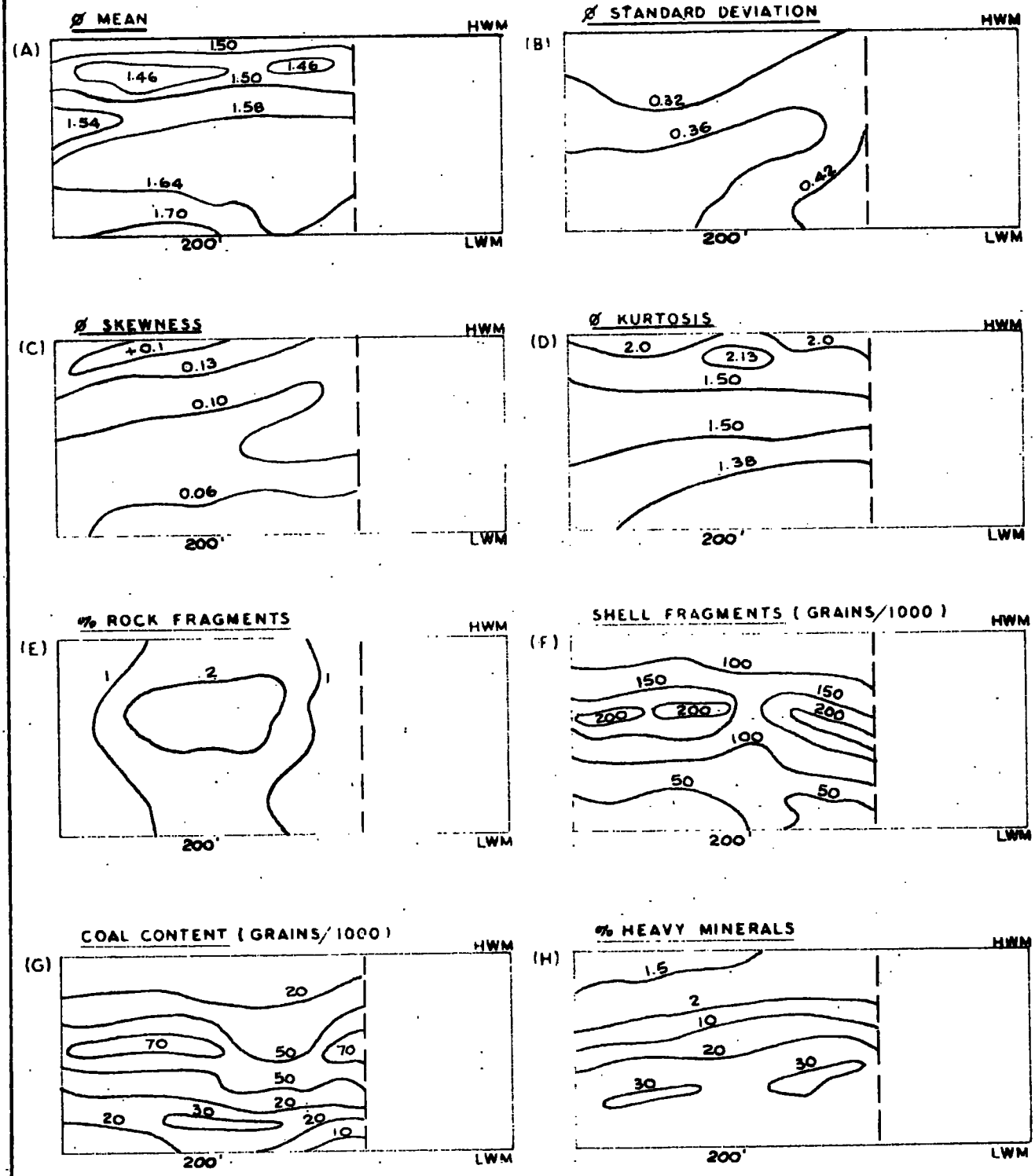
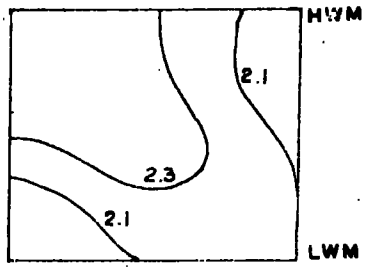


FIG.51

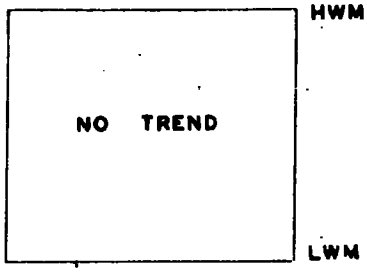
SALTBURN BEACH (N.)

SHOWING SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS

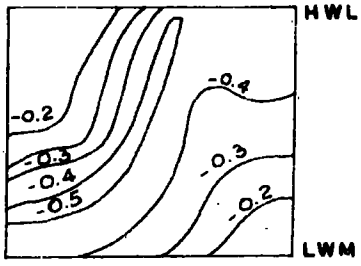
A. Ø MEAN



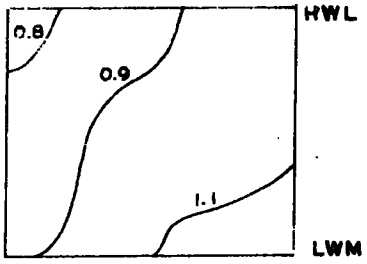
B. Ø STD. DEV.



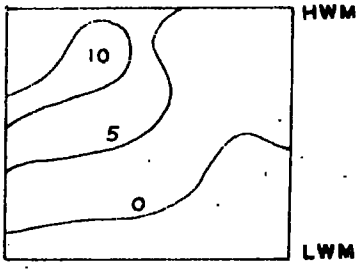
C. Ø SKEWNESS



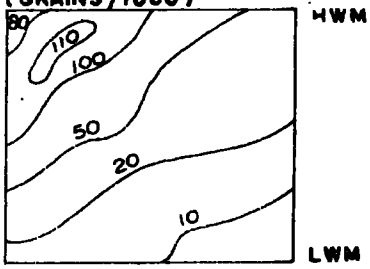
D. Ø KURTOSIS



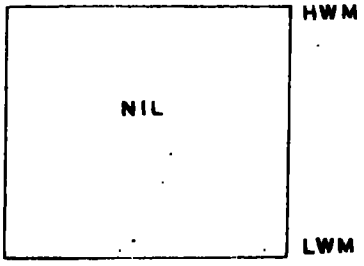
E. % ROCK FRAGMENTS



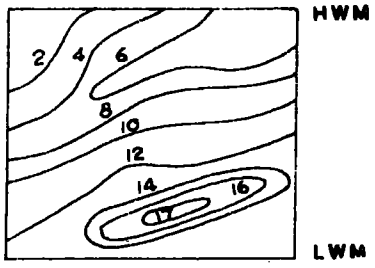
F. SHELL FRAGMENTS (GRAINS/1000)



G. COAL CONTENT (GRAINS/1000)



H. %. HEAVY MINERALS

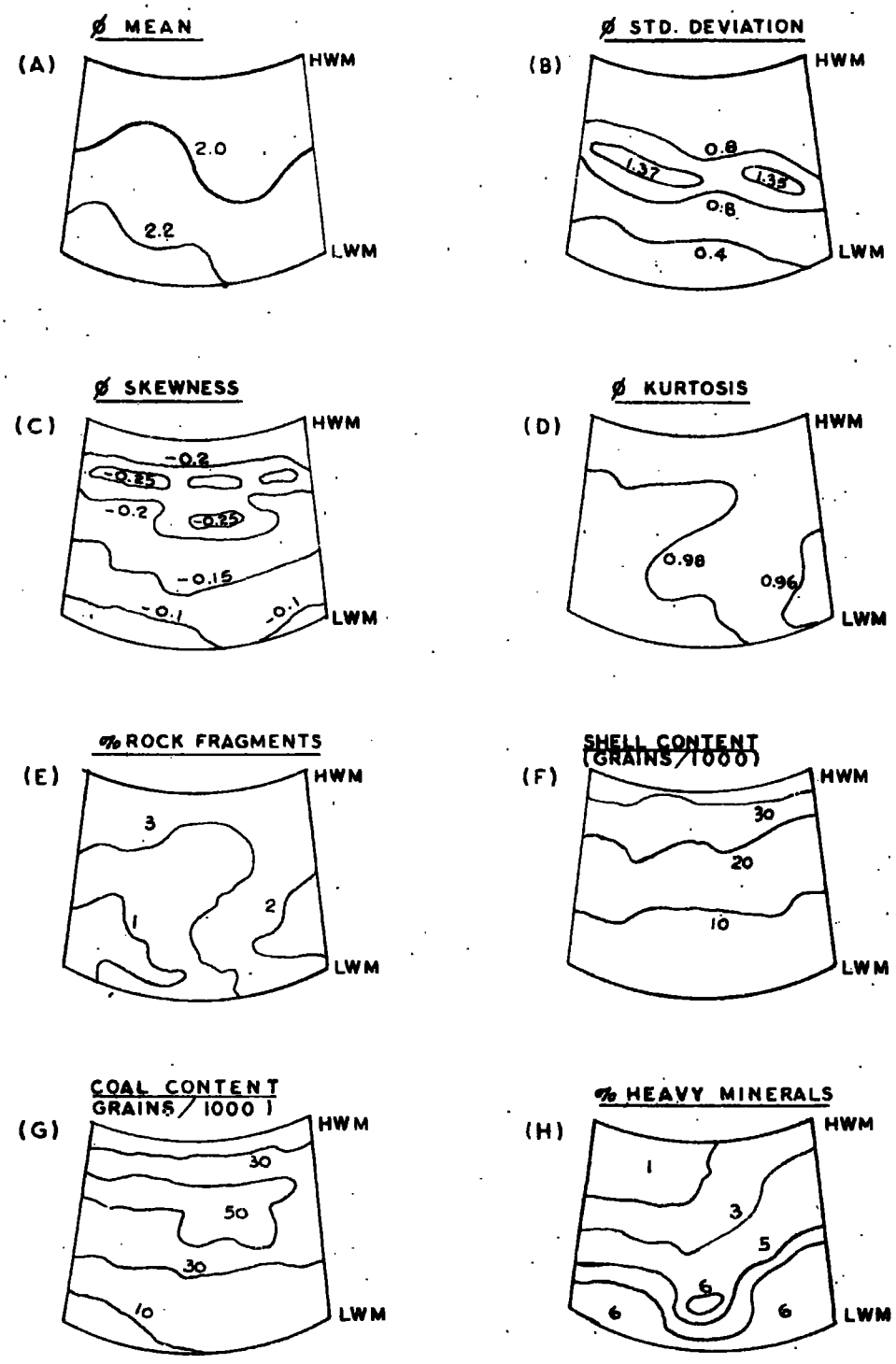


SCALE : 1" = 100'

FIG. 52

HARTLEPOOL YACHT CLUB BEACH

SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS



SCALE: 1" = 100'

FIG.53

MARSKE BEACH
SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS

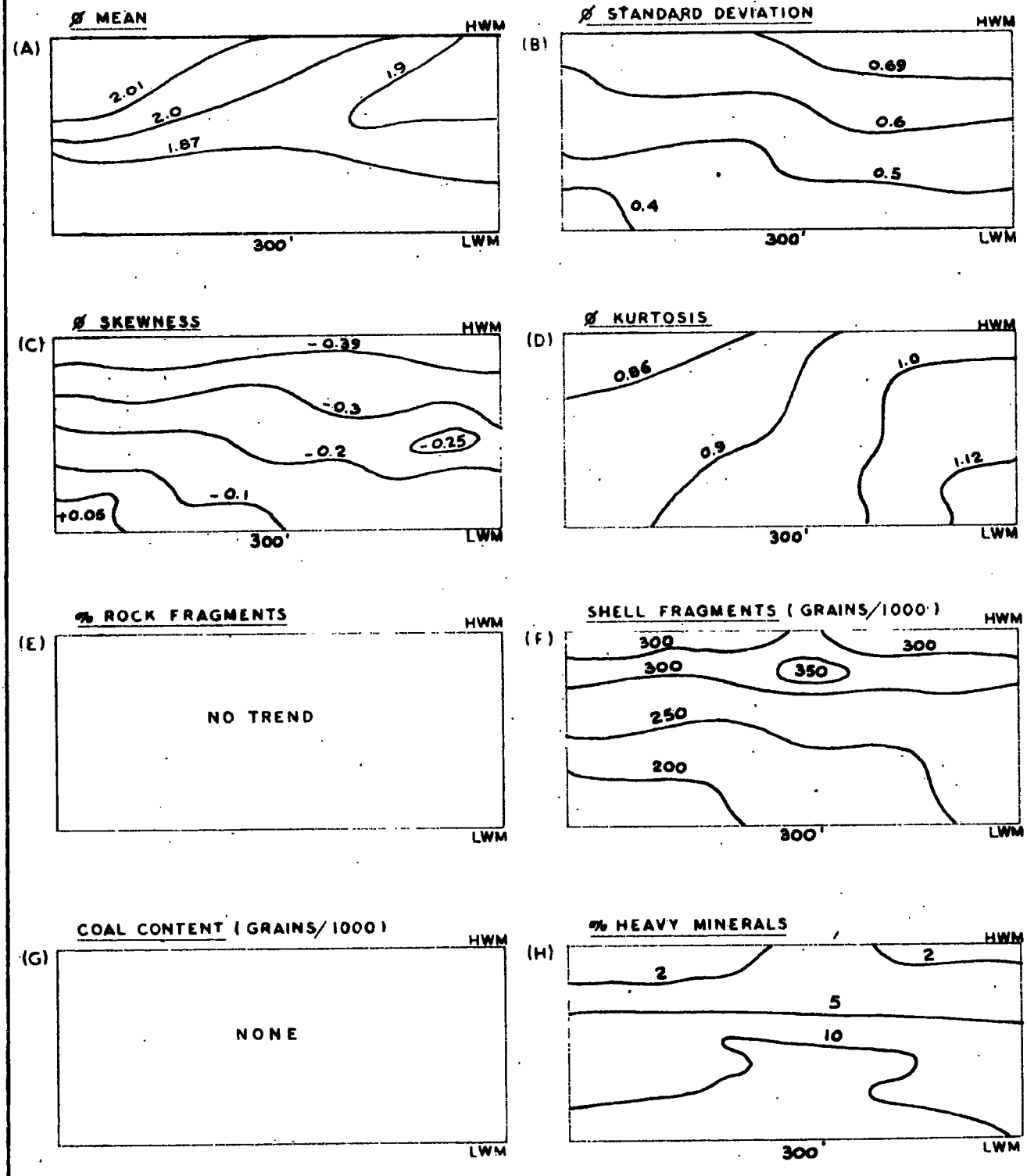


FIG. 54.

REDCAR BEACH

SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS

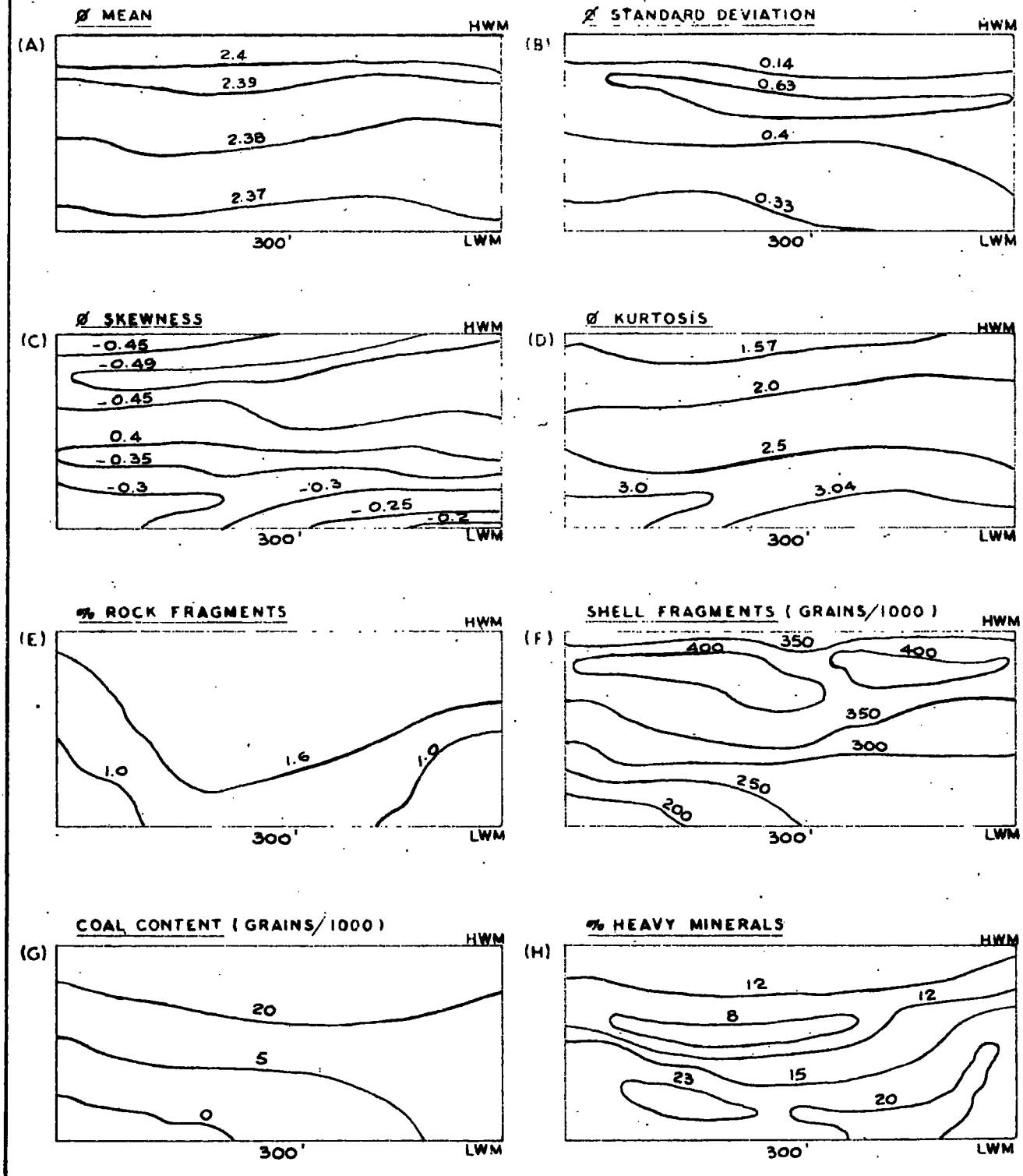


FIG 55

SEATON CAREW BEACH
SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS

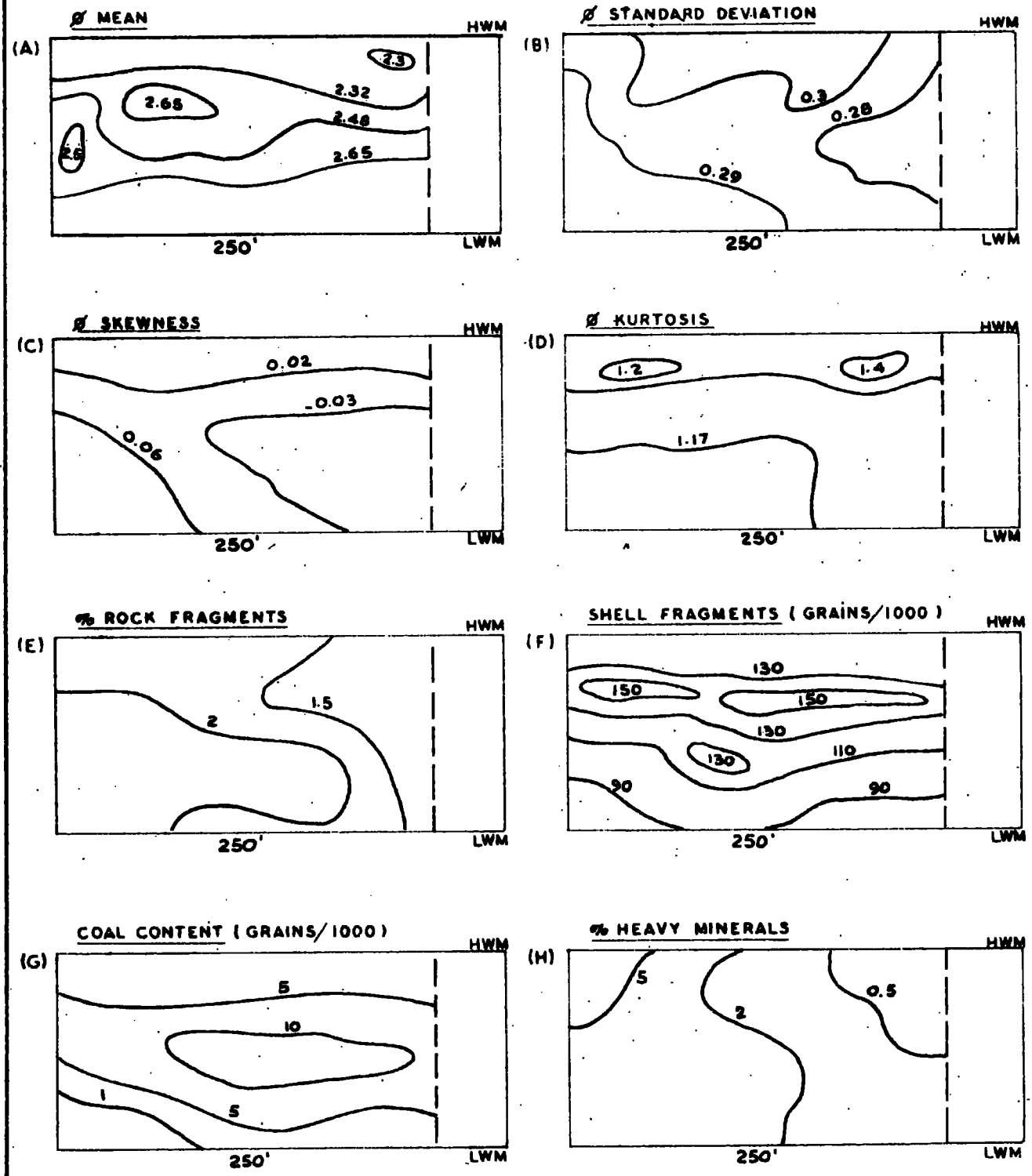


FIG. 56

PARTICLE SIZE

TYPICAL CURVES FROM THE SIX BEACH SITES

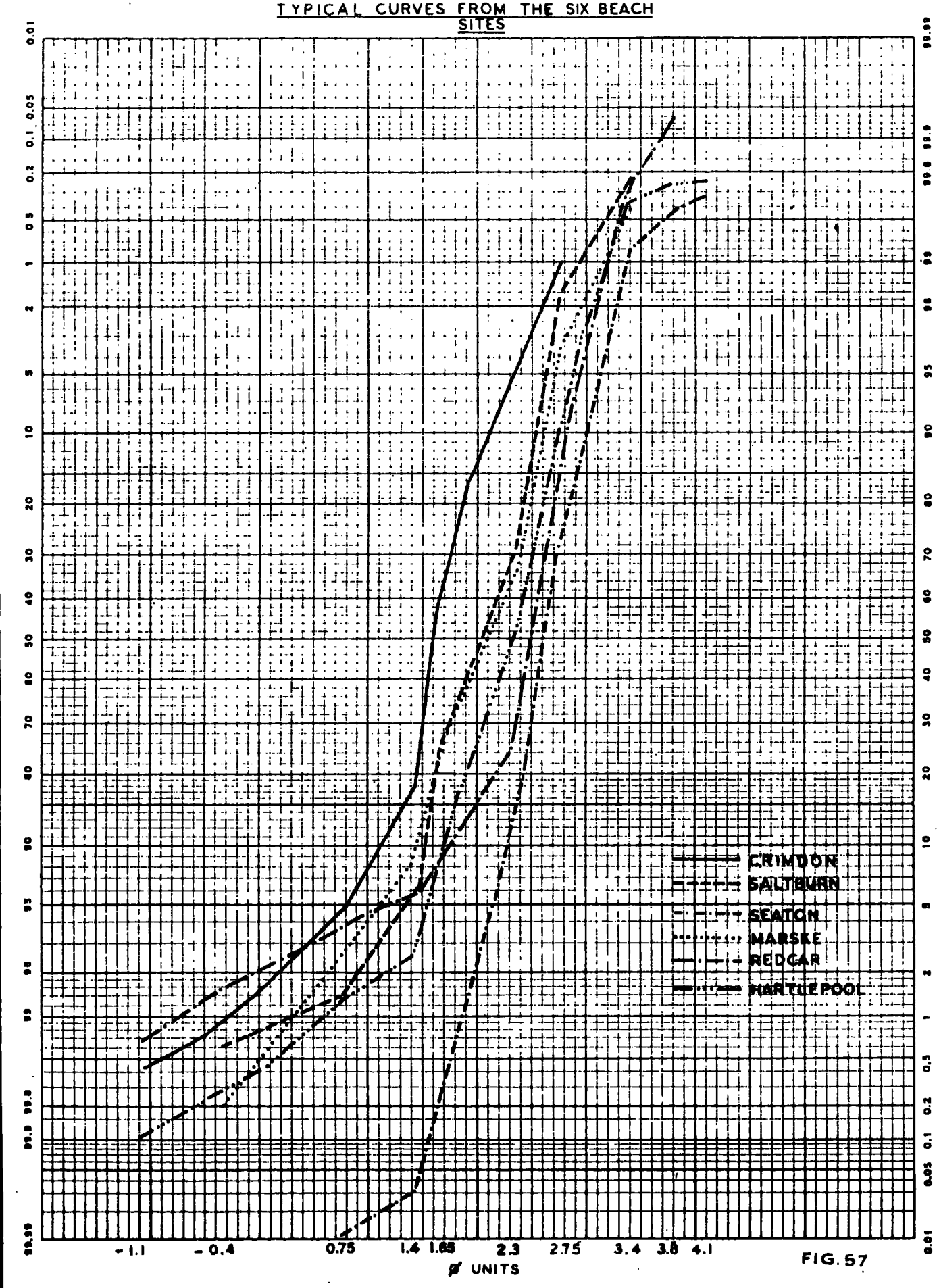


FIG. 57

THE LOCATION OF DUNE SAMPLES

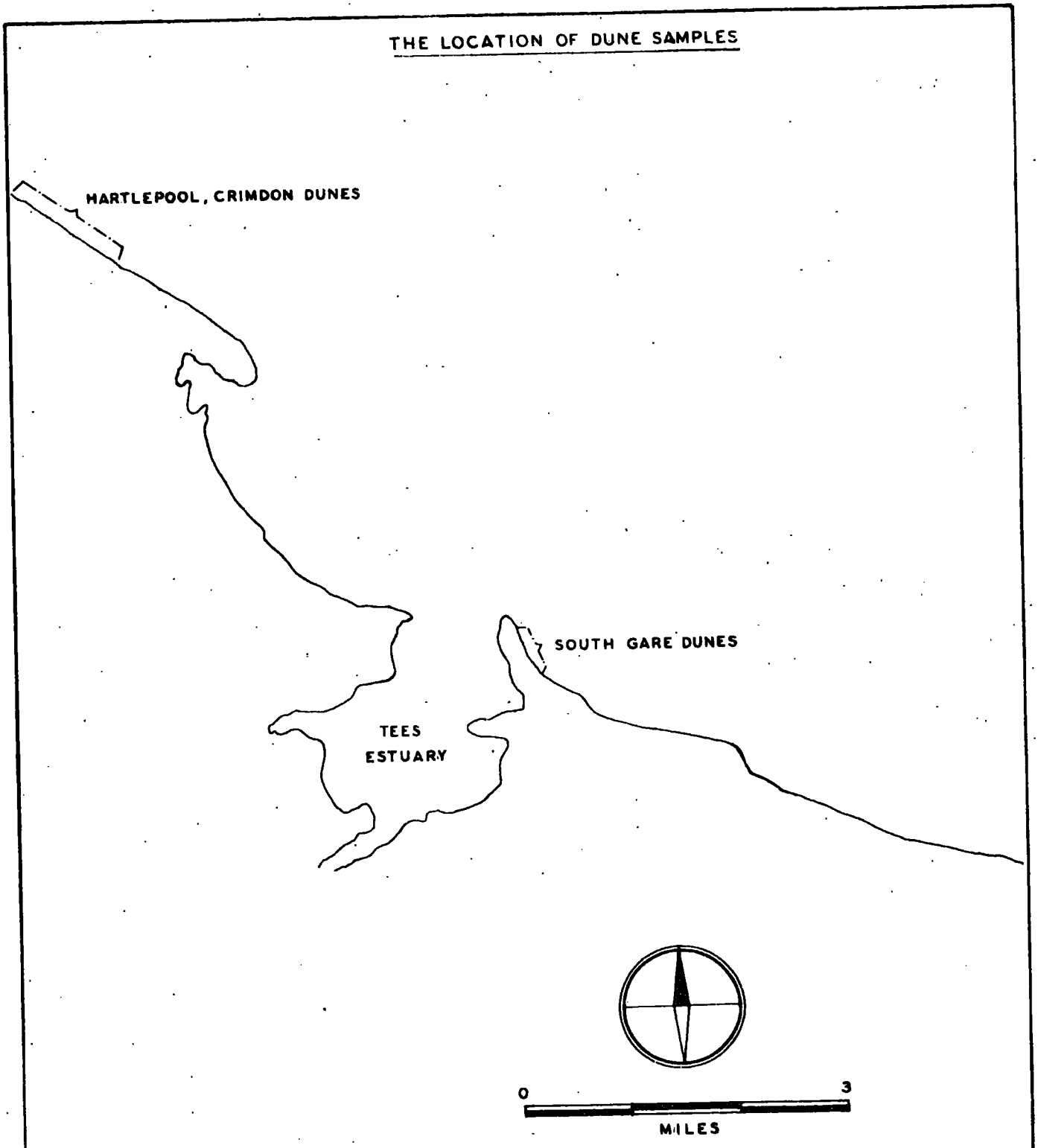


FIG. 58

HARTLEPOOL TO CRIMDON DUNE BELT
SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS

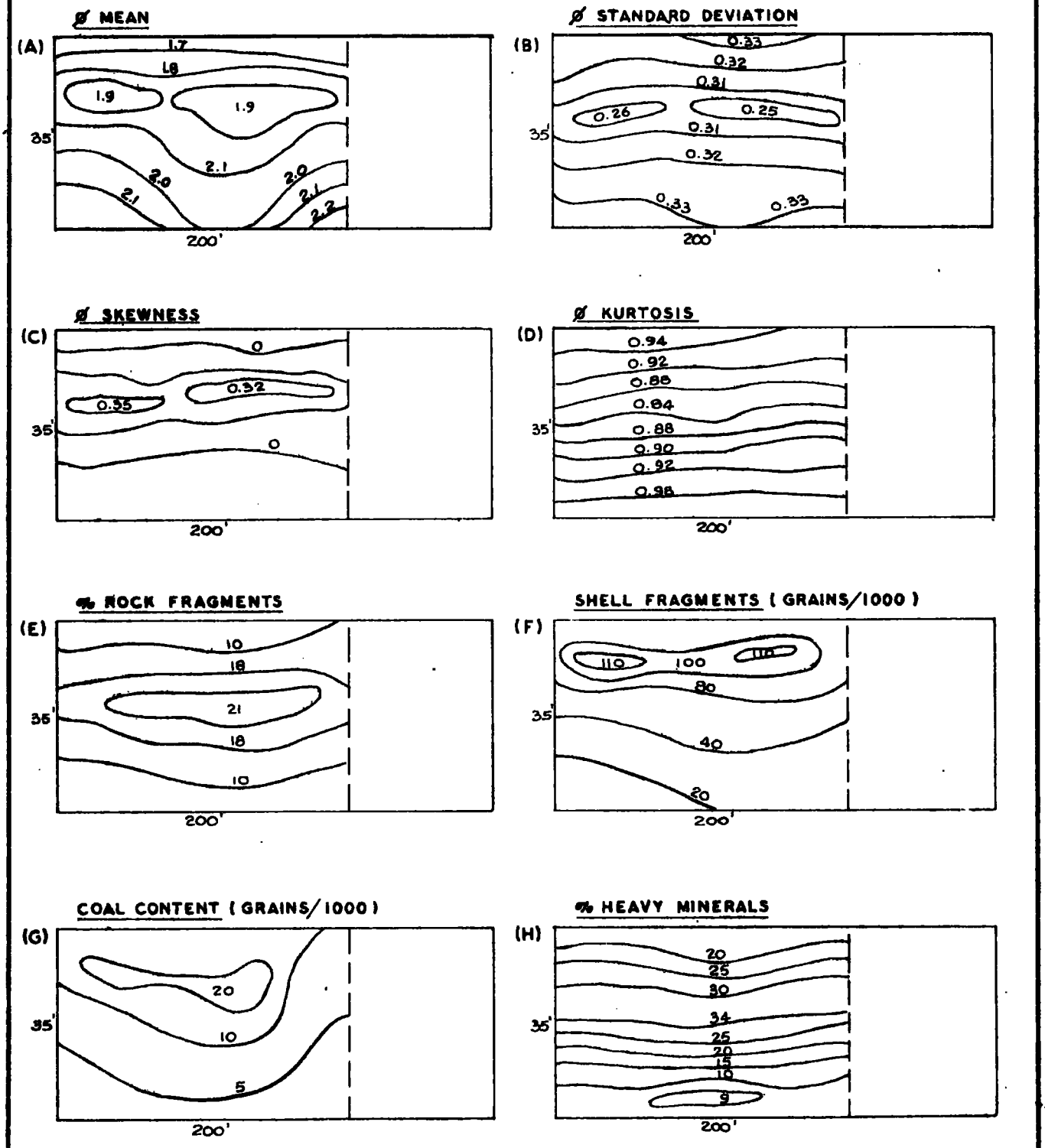


FIG. 59

SOUTH GARE DUNE BELT

SPATIAL DISTRIBUTION OF SEDIMENTARY CHARACTERISTICS

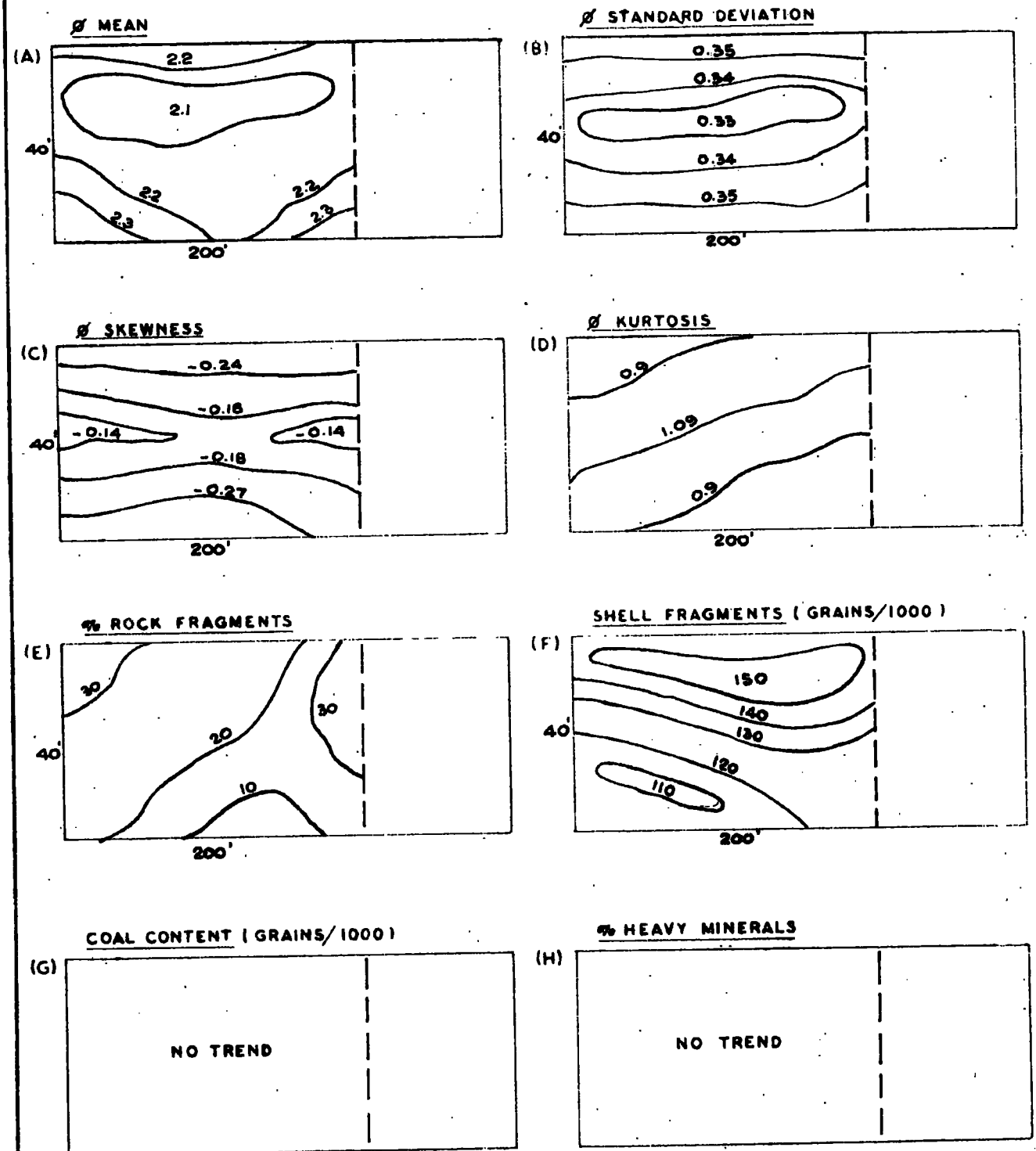


FIG. 60

TYPICAL CURVES OF DUNE SAMPLES

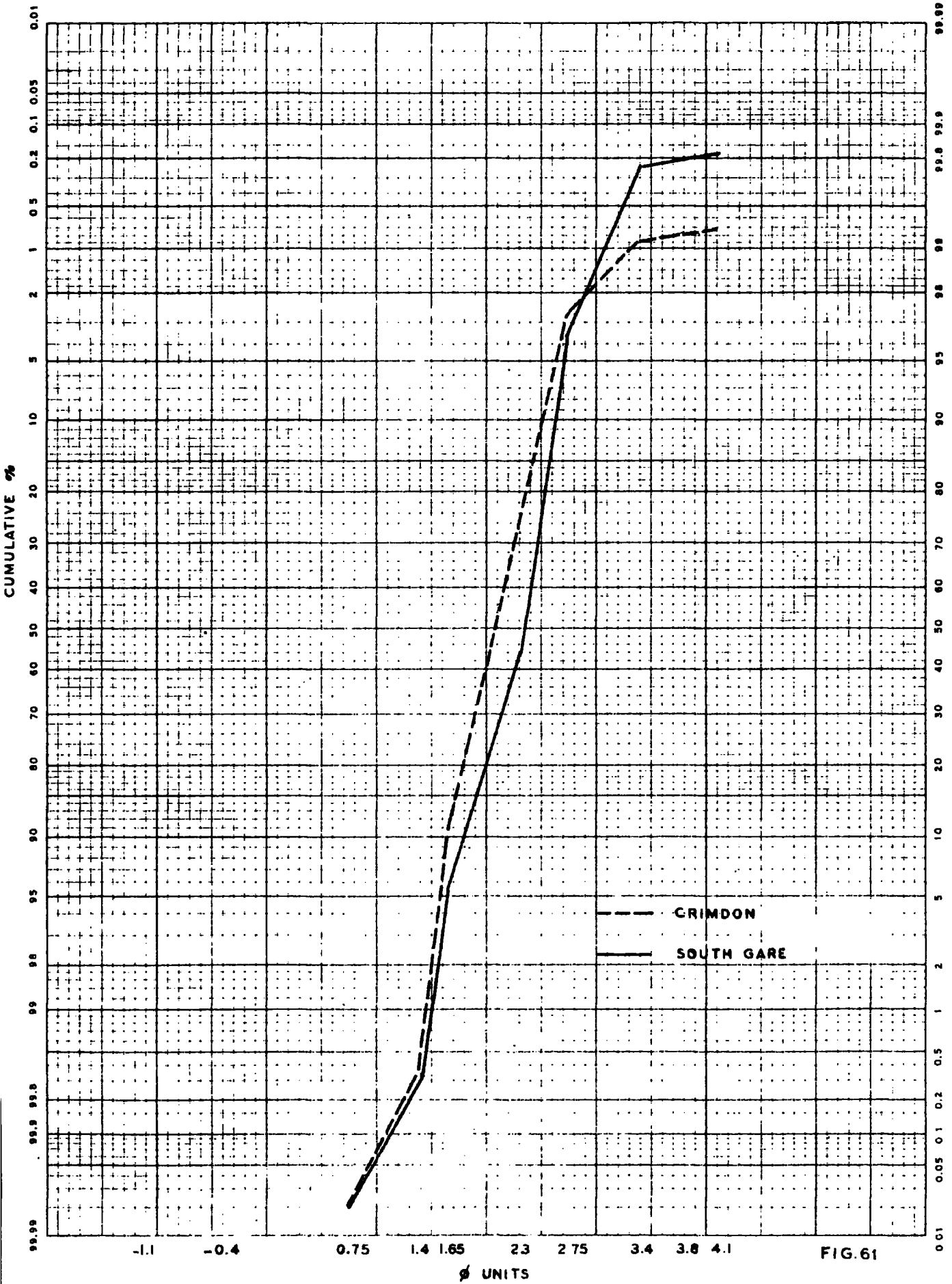


FIG. 61

LOCATION OF RIVER SAMPLES

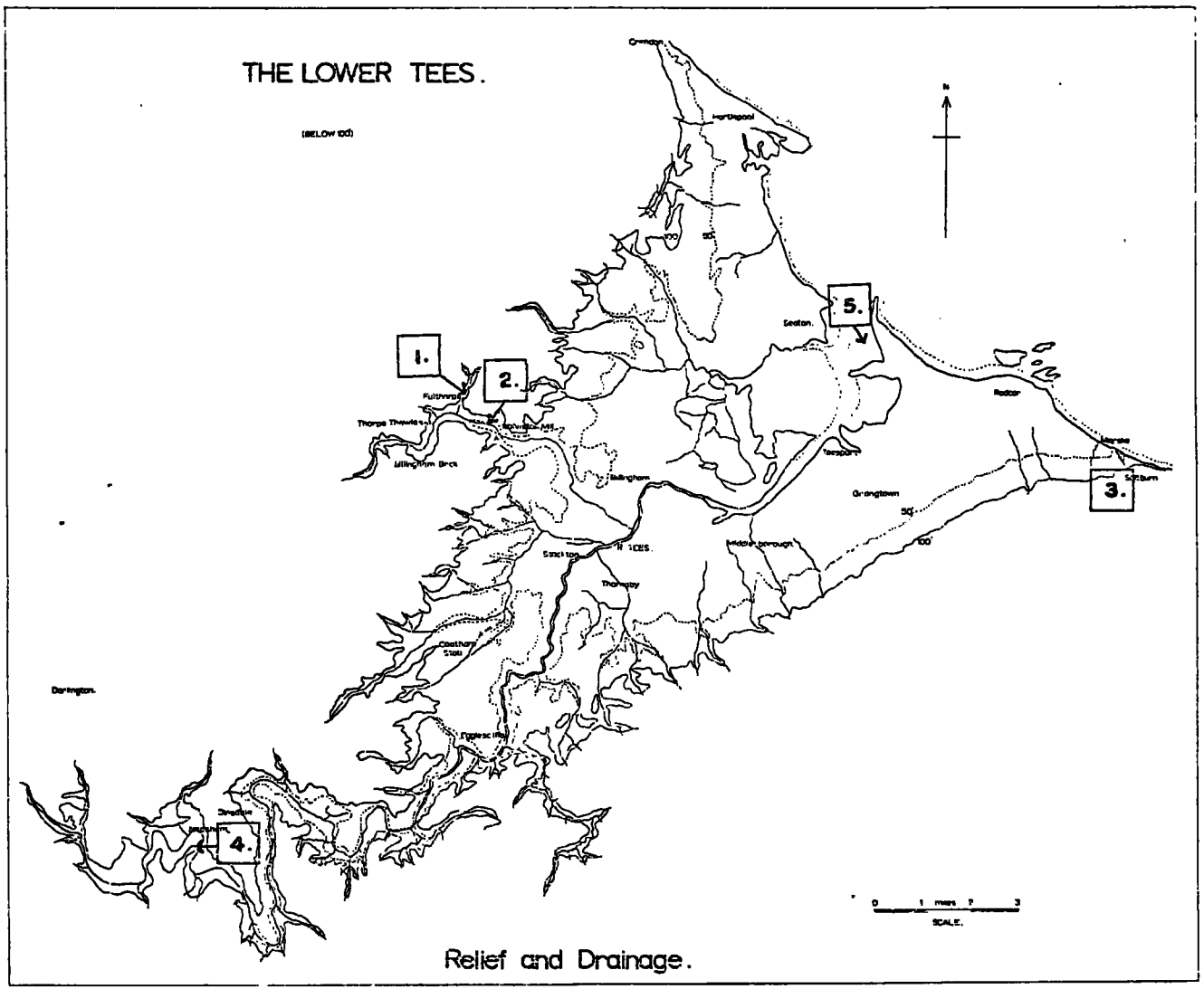
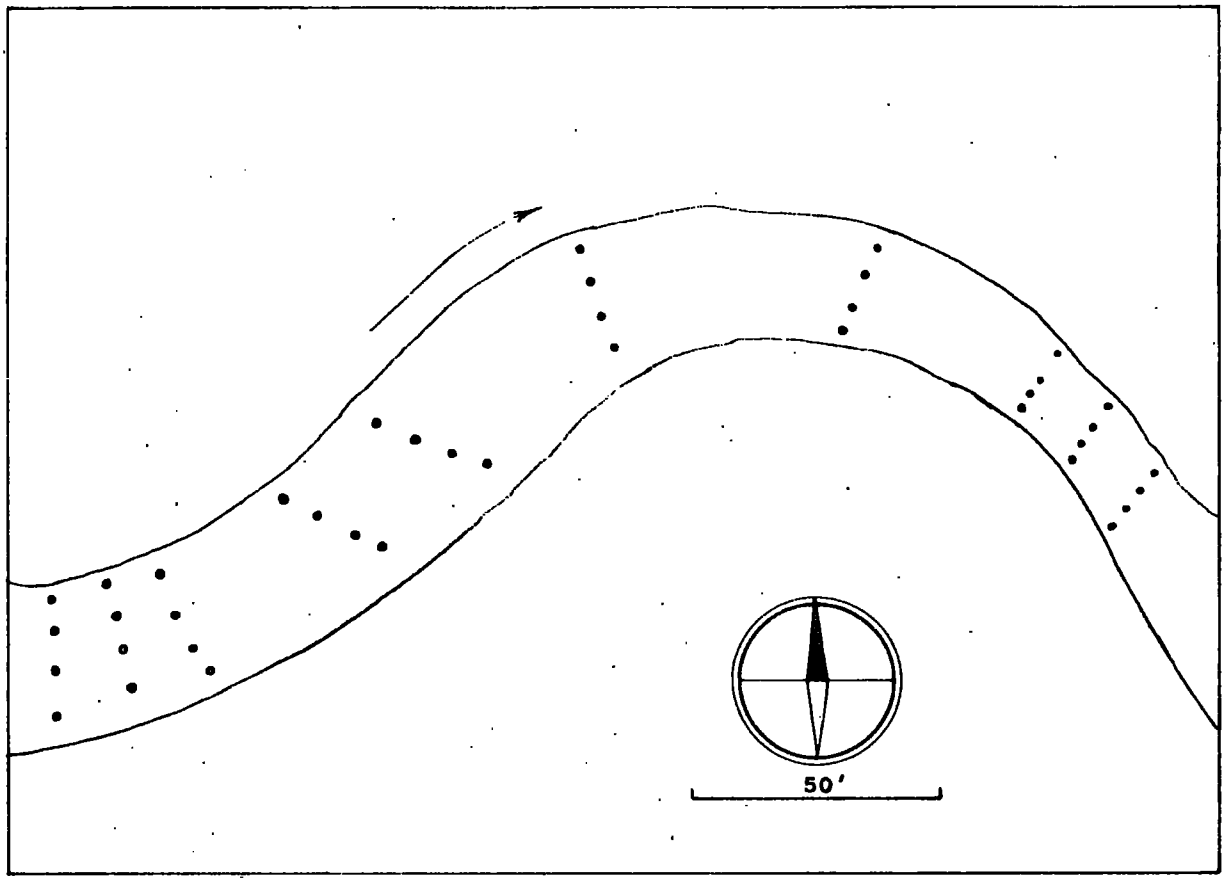
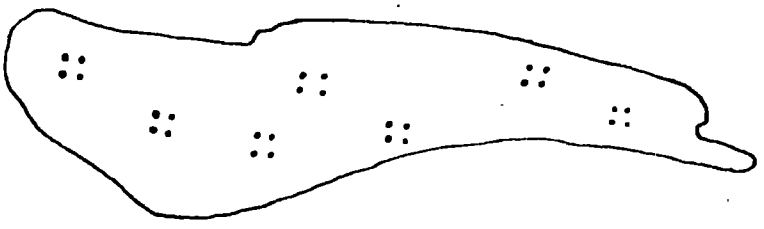


FIG. 62

THE LOCATION OF FLUVIAL SAMPLES IN THE RIVER TEES



SAND BAR IN THORPE THEWLES BECK, ENGLAND.

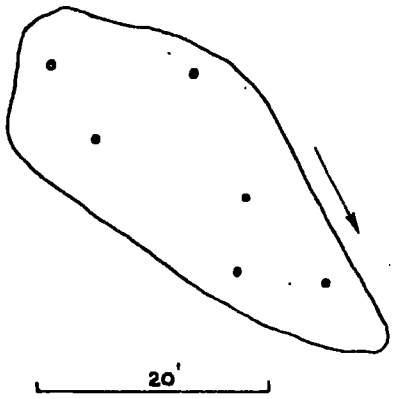


SIMILAR SORTING BUT
DECREASING SIZE

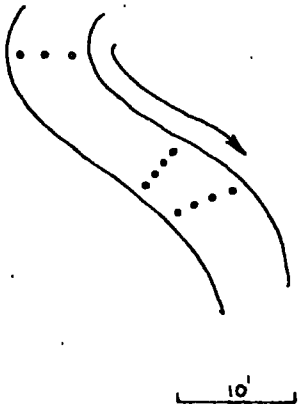
FIG.63

THE LOWER TEES
LOCATION OF RIVER SAMPLES

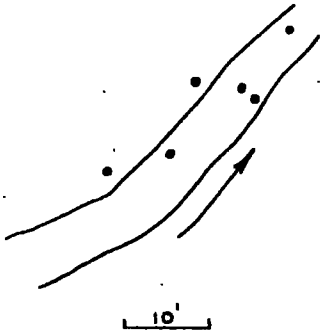
SAMPLE AREA 1.
THORPE THEWLES BECK
(SANDBANK)



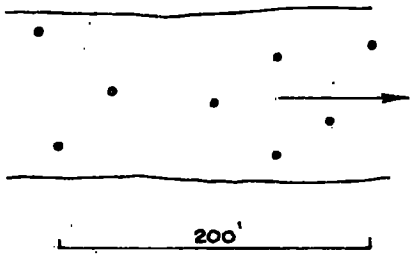
SAMPLE AREA 2.
BILLINGHAM BECK



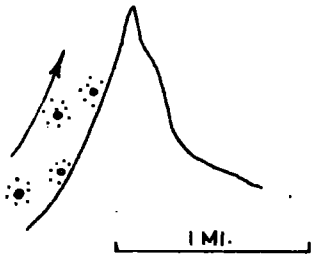
SAMPLE AREA 3.
SKELTON BECK
(SALTBURN)



SAMPLE AREA 4.
R. TEES (NEASHAM)



SAMPLE AREA 5
S. GARE ESTUARY



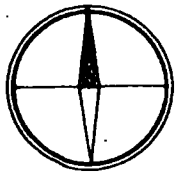
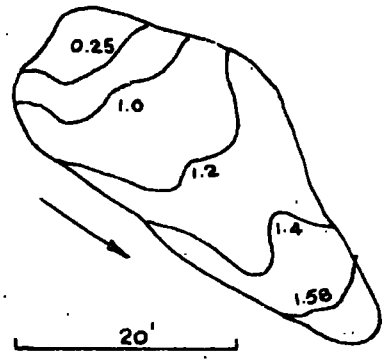


FIG. 64

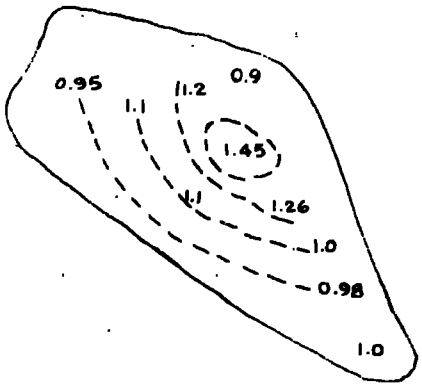
THORPE THEWLES BECK

SPATIAL VARIATION OF SEDIMENTARY CHARACTERISTICS

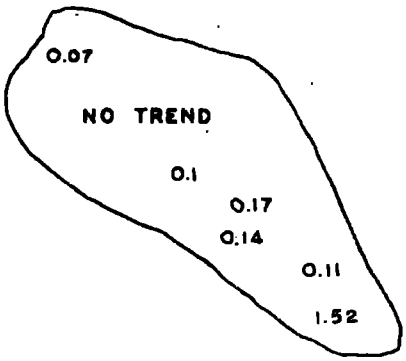
(A) Ø MEAN



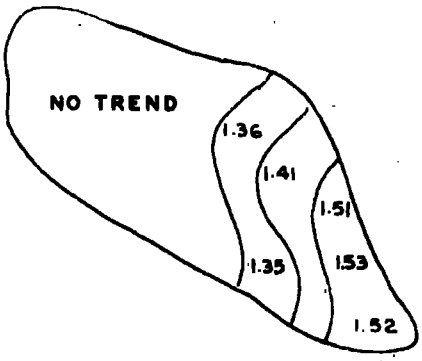
(B) Ø STANDARD DEVIATION



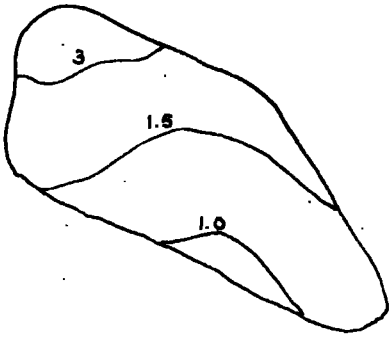
(C) Ø SKEWNESS



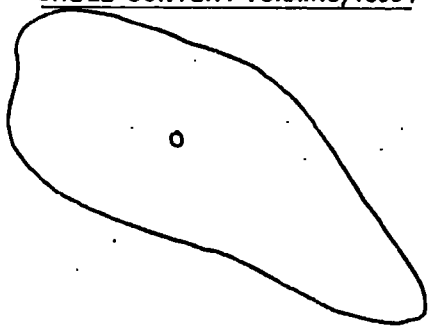
(D) Ø KURTOSIS



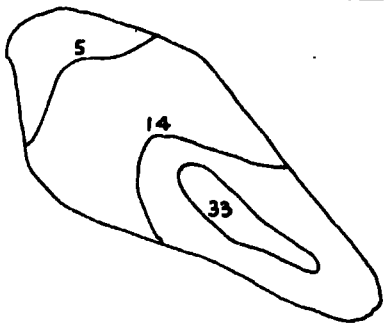
(E) % ROCK FRAGMENTS



(F) SHELL CONTENT (GRAINS/1000)



(G) COAL CONTENT (GRAINS/1000)



(H) % HEAVY MINERALS

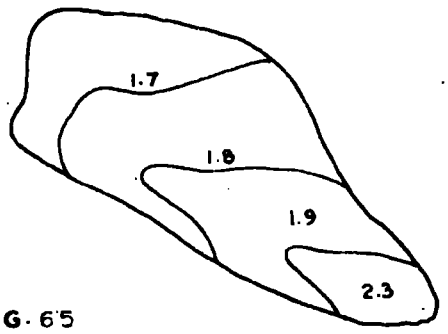
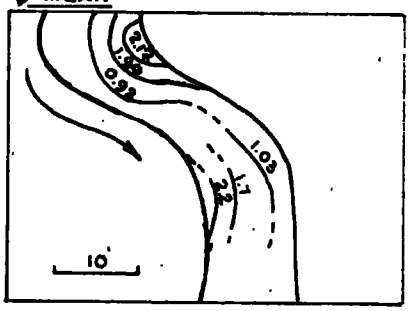


FIG. 6'5

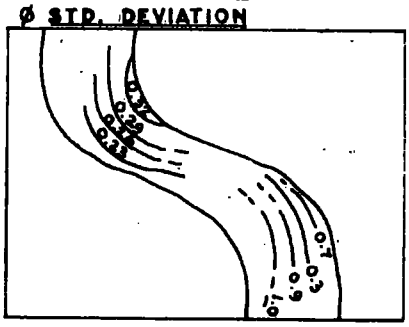
SPATIAL VARIATIONS OF SEDIMENTARY CHARACTERISTICS

BILLINGHAM BECK

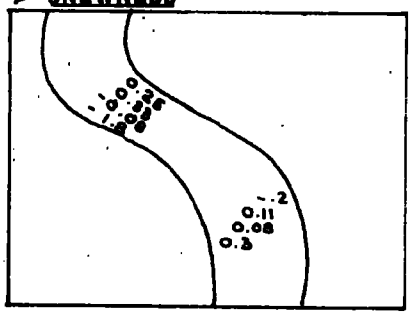
(A) Ø MEAN



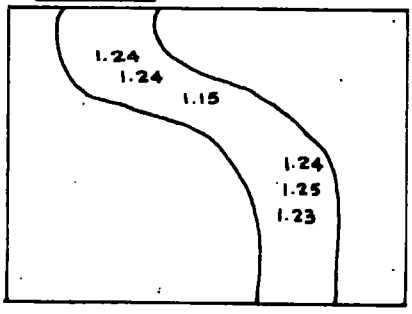
(B) Ø STD. DEVIATION



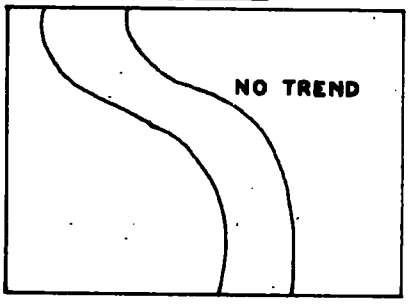
(C) Ø SKEWNESS



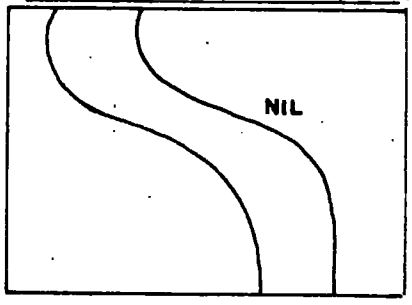
(D) Ø KURTOSIS



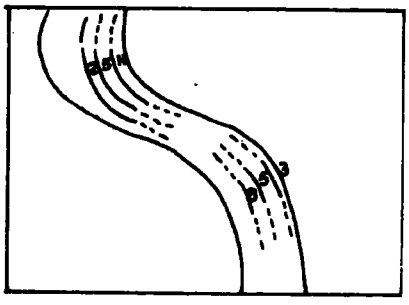
(E) % ROCK FRAGMENTS



(F) SHELL CONTENT (GRAINS/1000)



(G) COAL CONTENT (GRAINS/1000)



(H) % HEAVY MINERALS

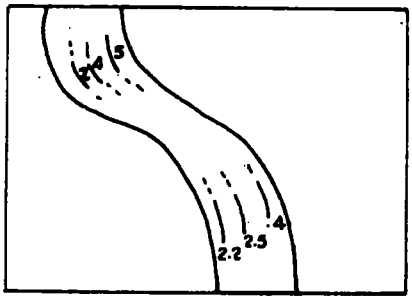
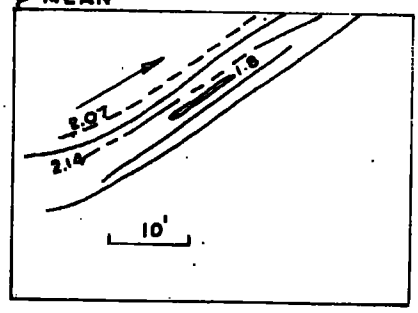


FIG. 66

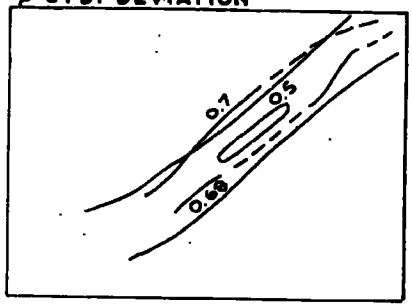
SPATIAL VARIATION OF SEDIMENTARY CHARACTERISTICS

SKELTON BECK (SALTBURN)

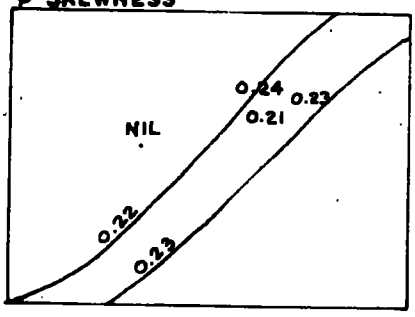
(A) Ø MEAN



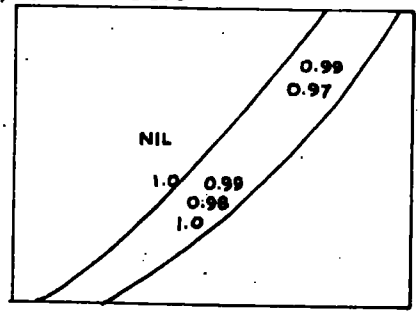
(B) Ø STD. DEVIATION



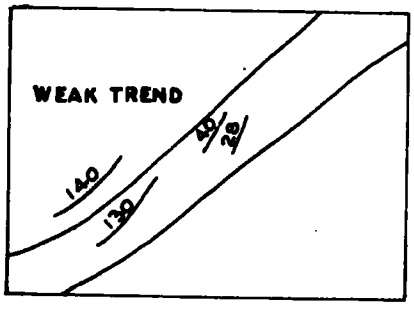
(C) Ø SKEWNESS



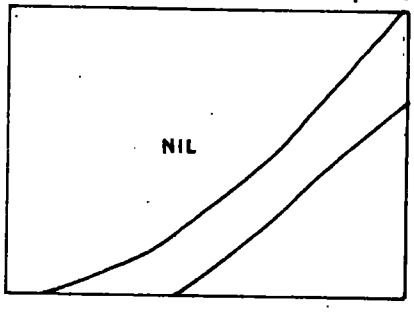
(D) Ø KURTOSIS



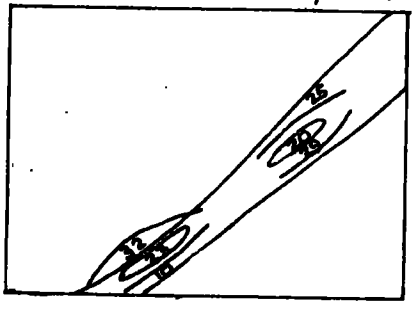
(E) % ROCK FRAGMENTS



(F) SHELL FRAGMENTS (GRAINS/1000)



(G) COAL CONTENT (GRAINS/1000)



(H) % HEAVY MINERALS

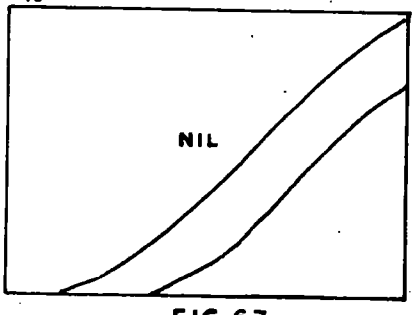
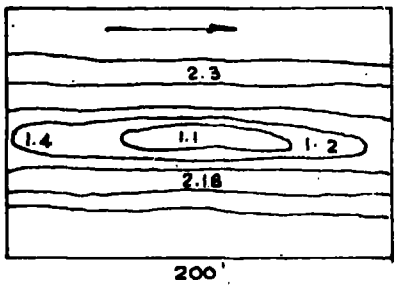


FIG. 67.

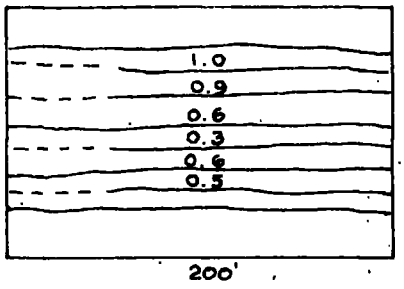
RIVER TEES
(NEASHAM)

AREAL VARIATION OF SEDIMENTARY CHARACTERISTICS

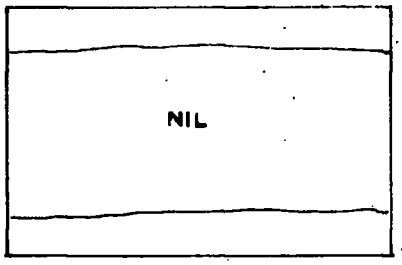
(A) ø MEAN



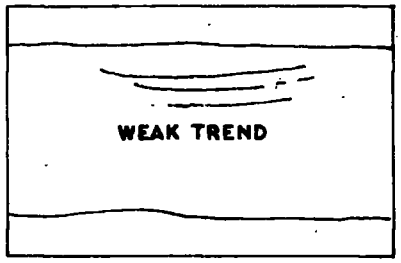
(B) ø DEVIATION (STD.)



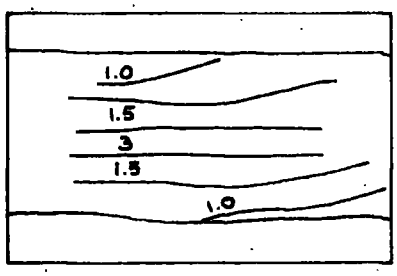
(C) ø SKEWNESS



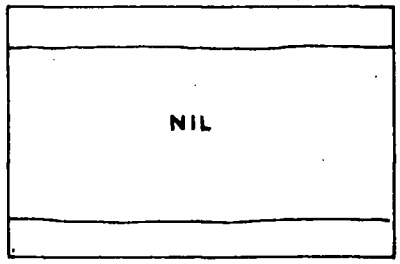
(D) ø KURTOSIS



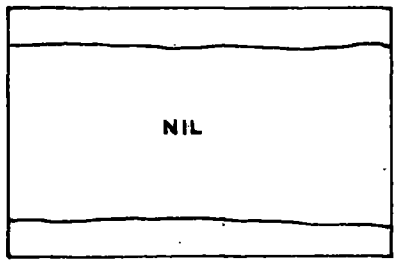
(E) % ROCK FRAGMENTS



(F) SHELL FRAGMENTS (GRAINS/1000)



(G) COAL CONTENT (GRAINS/1000)



(H) % HEAVY MINERALS

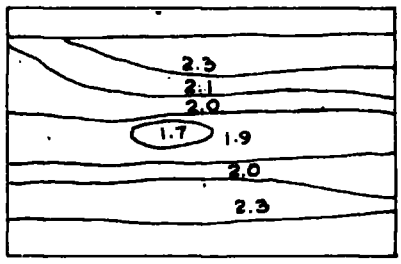
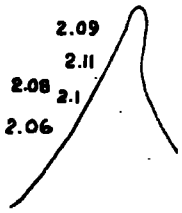


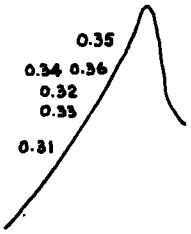
FIG. 68

SOUTH GARE ESTUARY
AREAL VARIATION OF SEDIMENTARY CHARACTERISTICS

(A) Ø MEAN

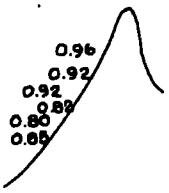


(B) ØSTD. DEVIATION

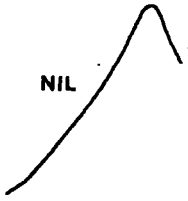


(C) Ø SKEWNESS

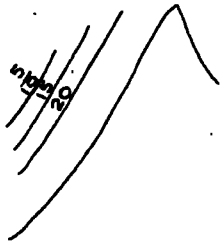
(D) Ø KURTOSIS



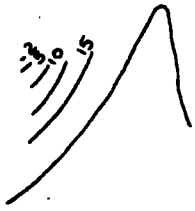
(E) % ROCK FRAGMENTS



(F) SHELL CONTENT (GRAINS/1000)



(G.) COAL CONTENT (GRAINS/1000)



(H) % HEAVY MATERIALS

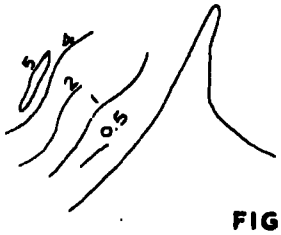


FIG.69

TYPICAL CURVES OF RIVER SAMPLES

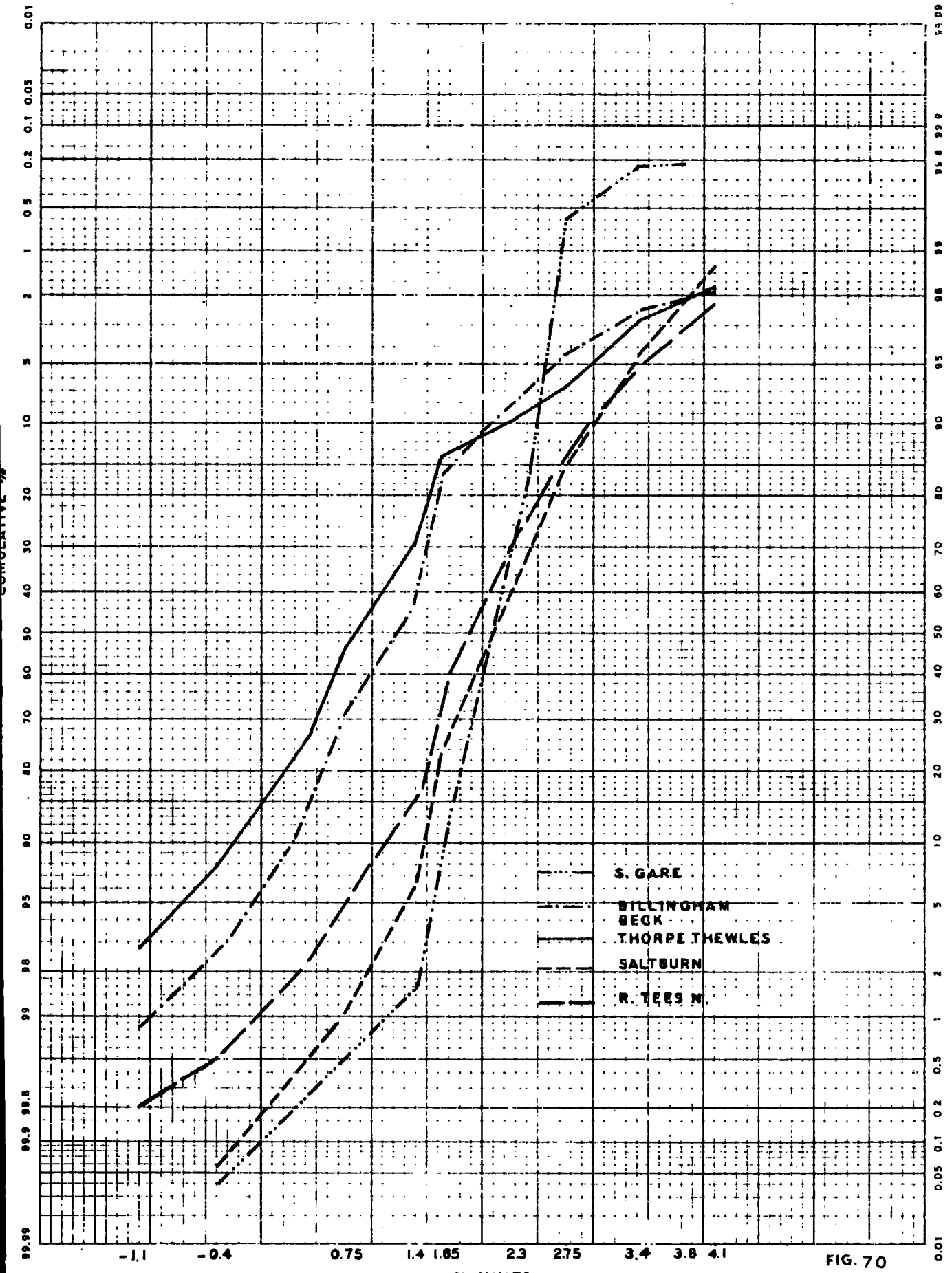


FIG. 70

THE LOCATION OF OFFSHORE SAMPLES
IN THE TEES BAY

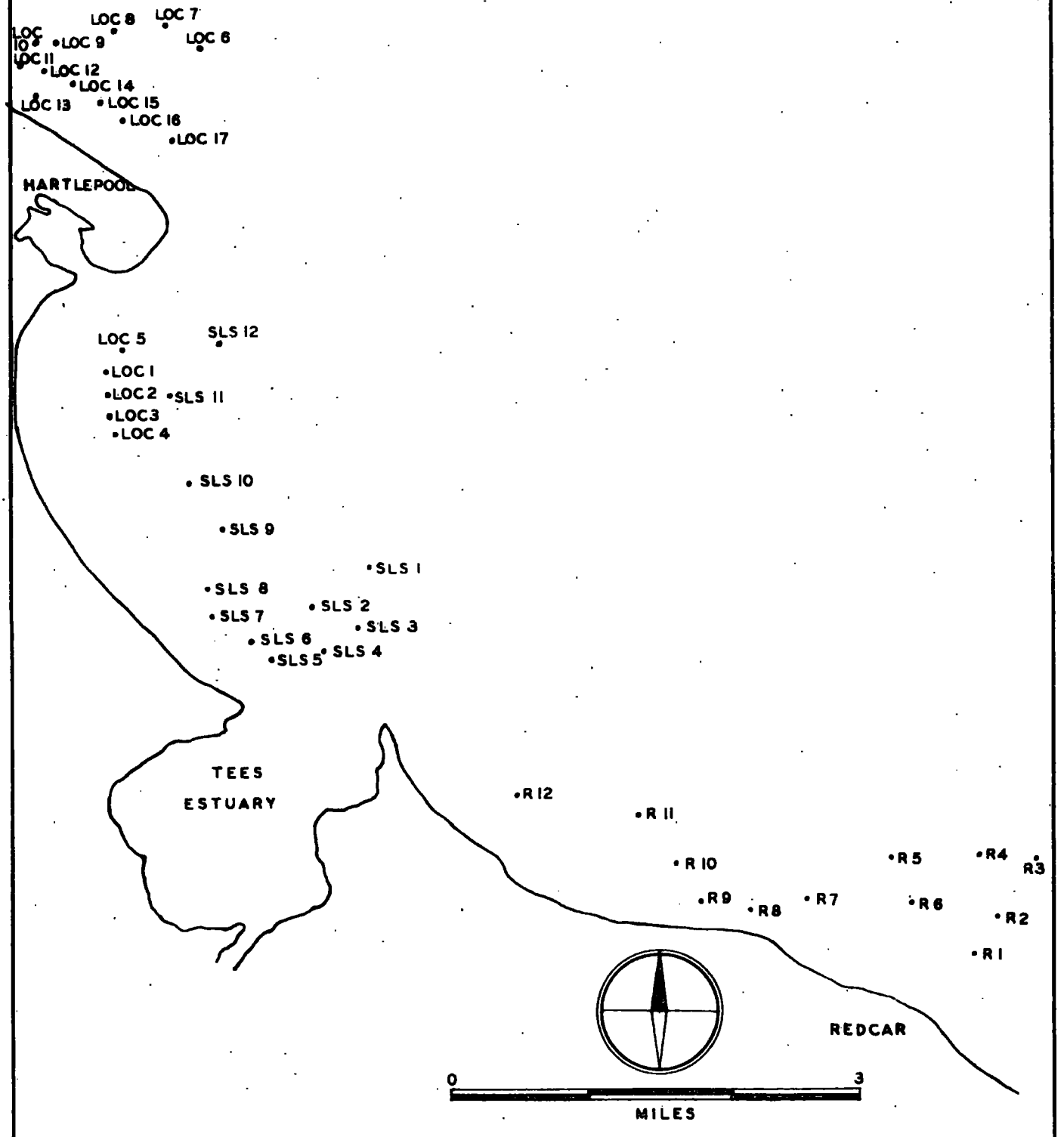


FIG. 71

OFFSHORE
SPATIAL VARIATION OF SEDIMENTARY CHARACTERISTICS

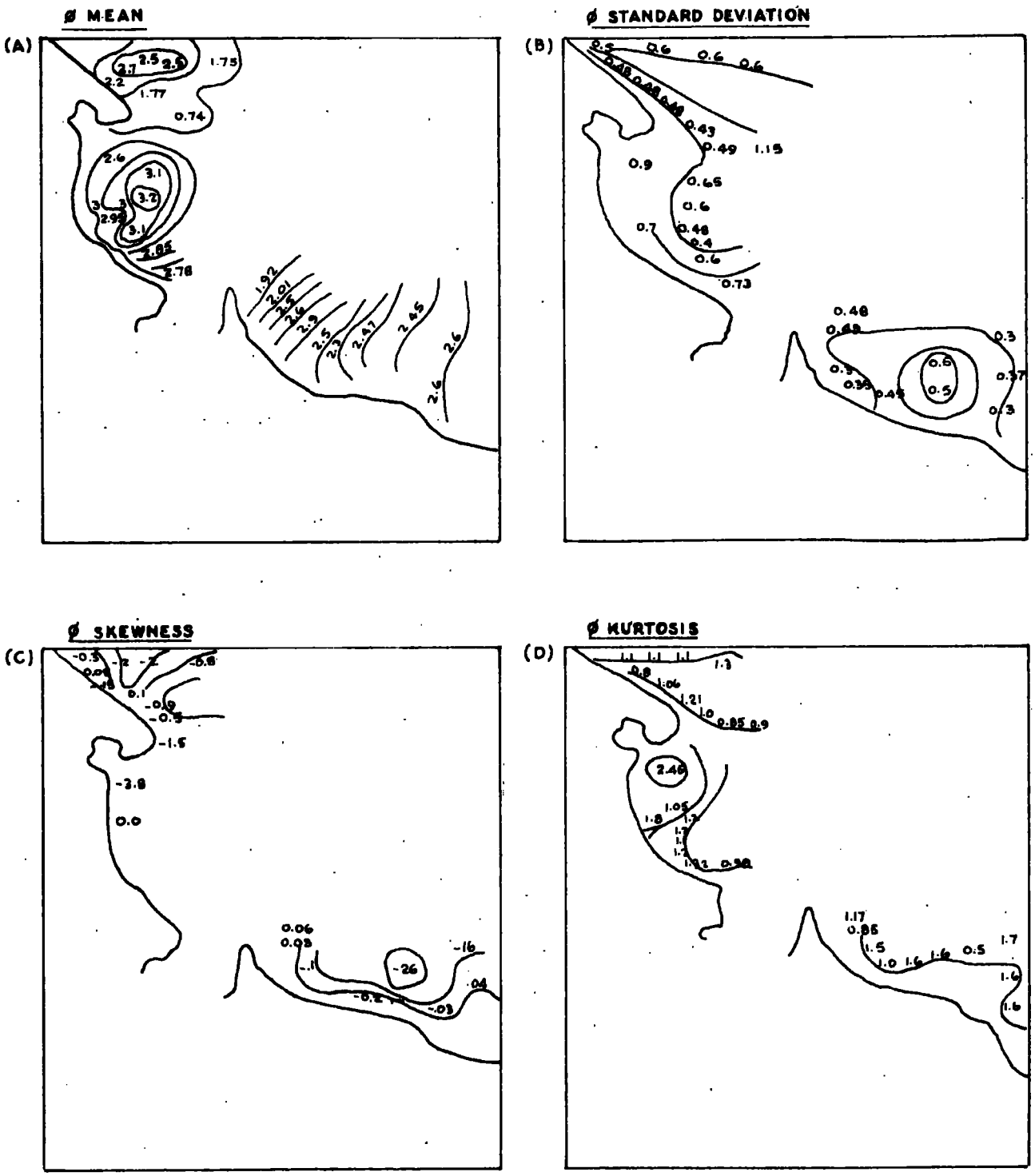
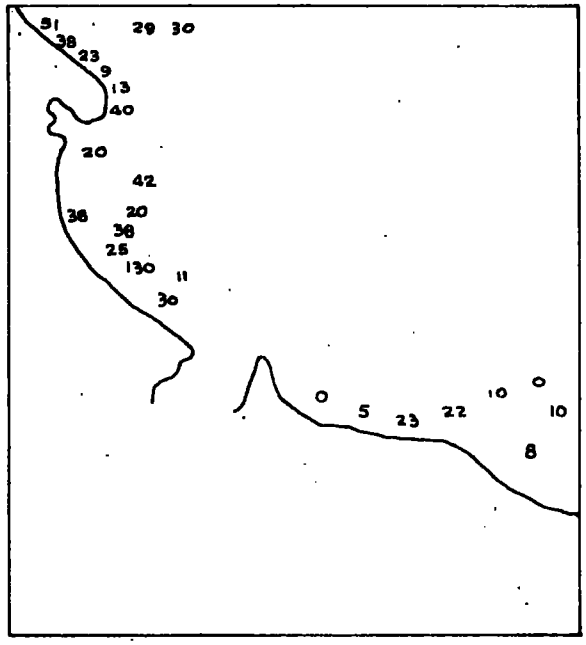


FIG. 72.

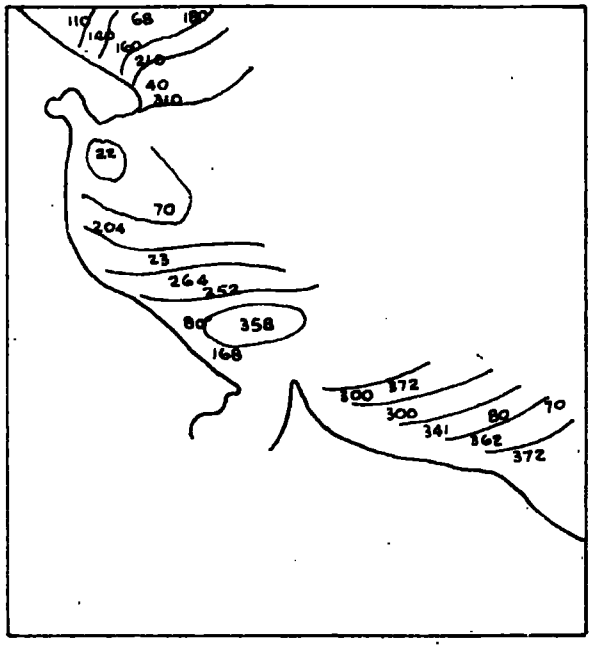
OFFSHORE

SPATIAL VARIATION OF SEDIMENTARY CHARACTERISTICS

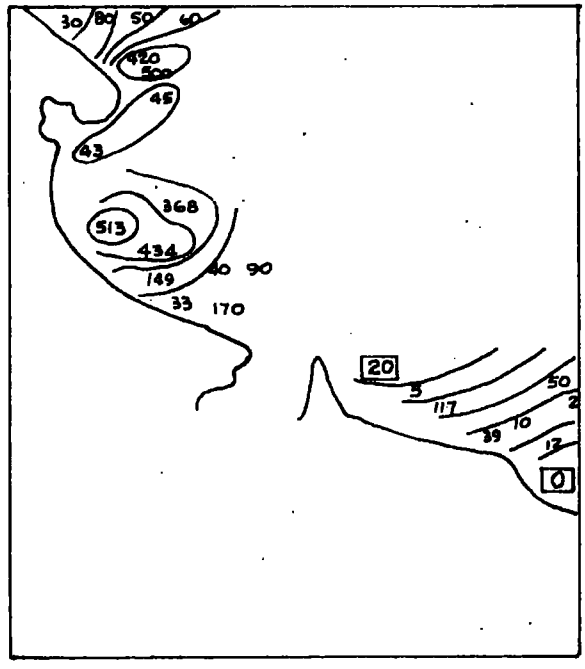
(E) % ROCK FRAGMENTS



(F) SHELL FRAGMENTS (GRAINS 1000)



(G) COAL CONTENT (GRAINS 1000)



(H) % HEAVY MINERALS

FIG. 7.3

TYPICAL CURVES OF OFFSHORE SAMPLES

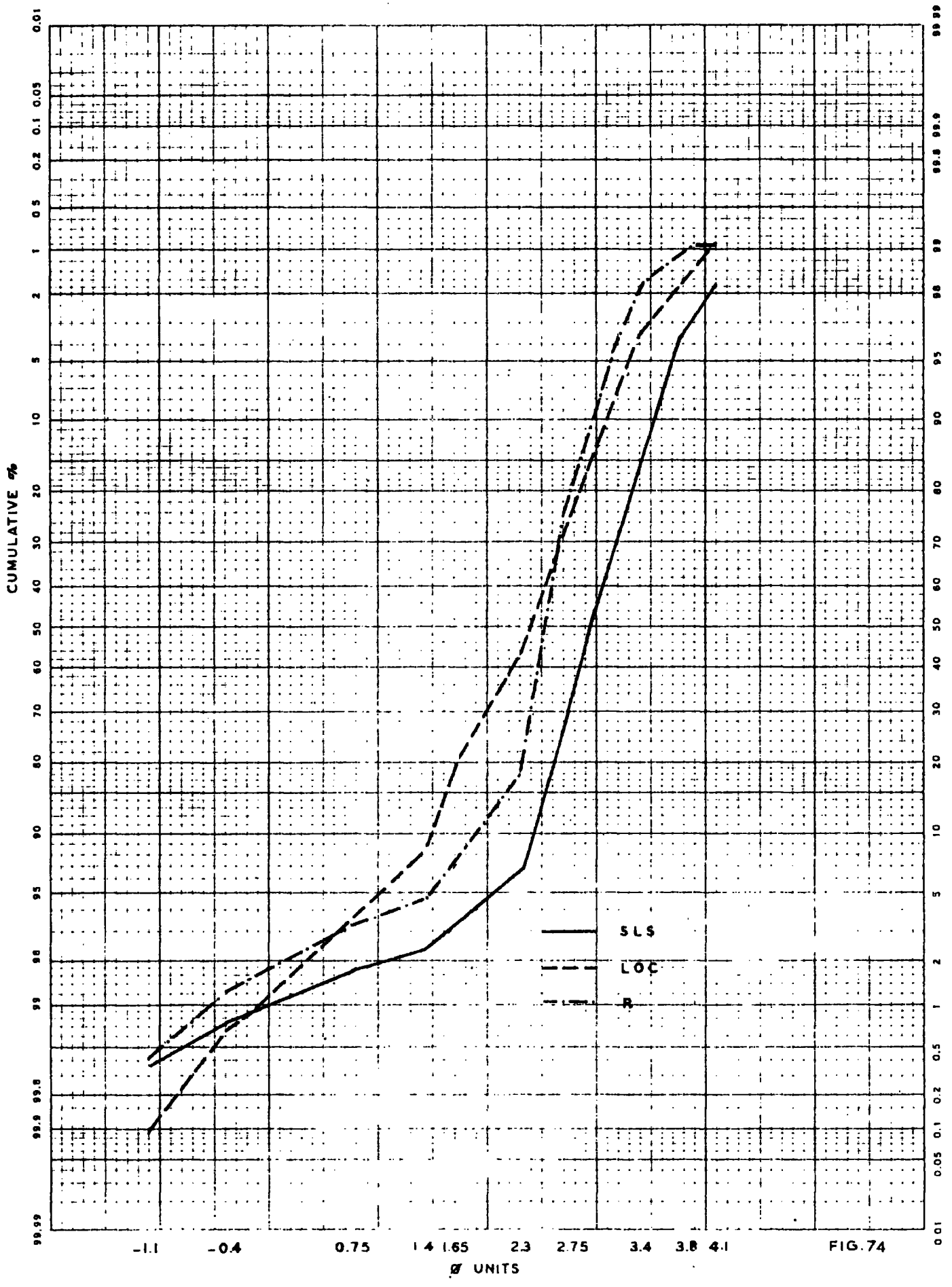
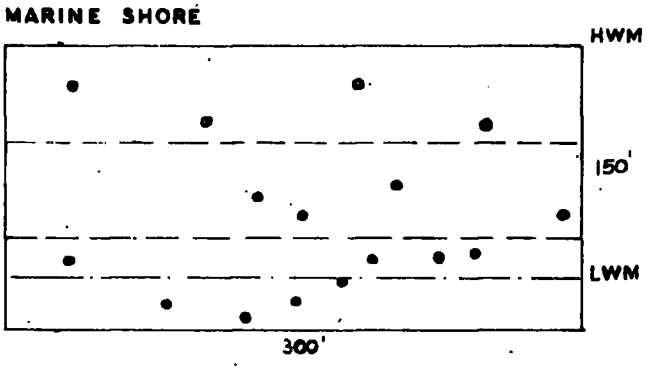


FIG. 74

DROMAN (SUTHERLAND, SCOTLAND)
LOCATION OF SAMPLES ON MARINE AND LAKE SHORES

MARINE SHORE



LAKE SHORE

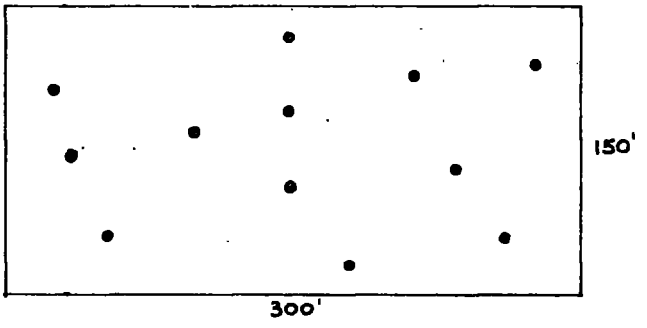


FIG. 75

TYPICAL CURVES OF SUTHERLAND MARINE AND LACUSTRINE SHORE DEPOSITS PLUS MARINE DEPOSIT LESS SHELL CONTENT.

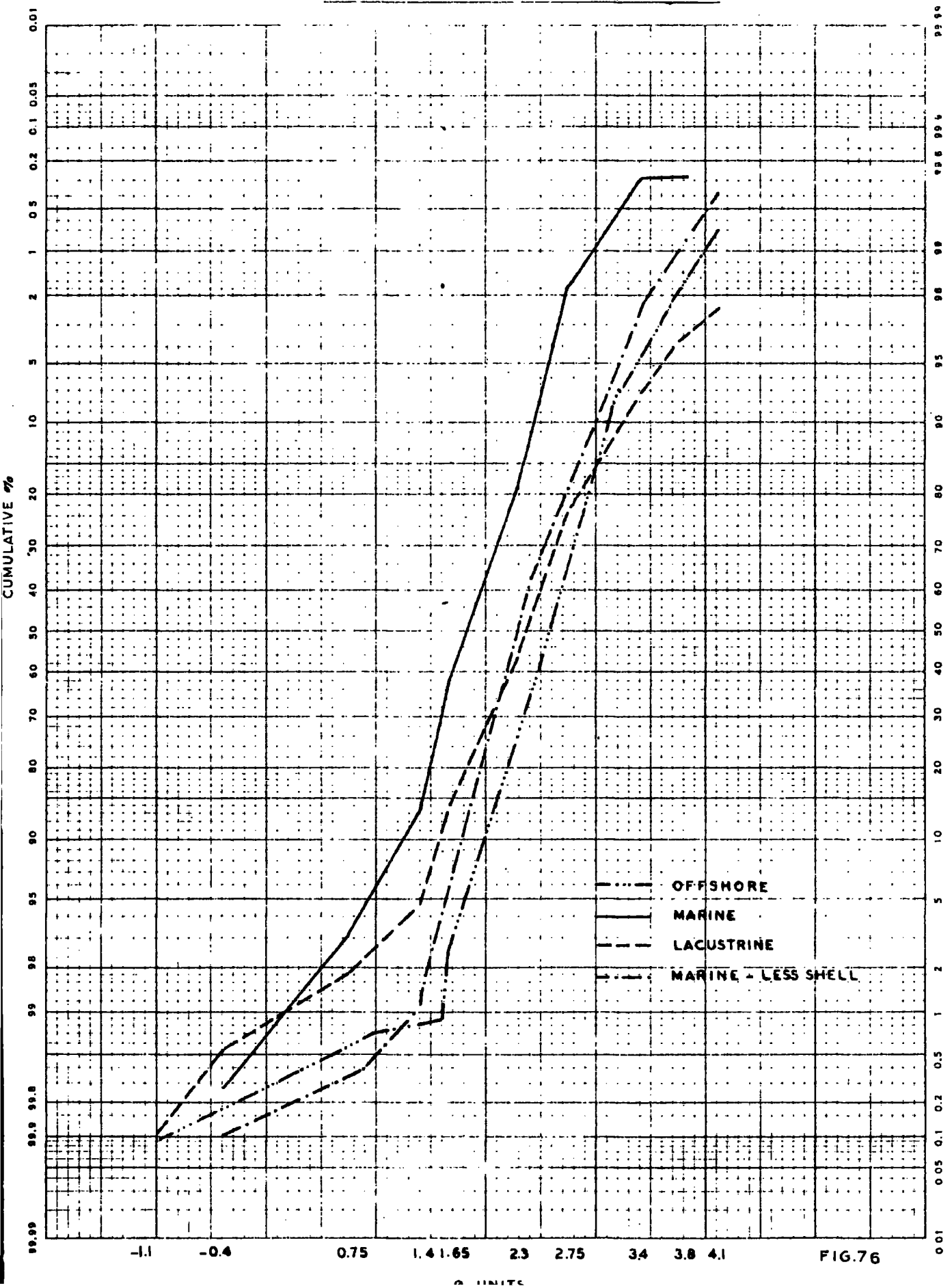


FIG.76

PARTICLE SIZE GRAPH DEMONSTRATING THE EFFECT OF SOURCE MATERIAL ON BEACH SEDIMENTS

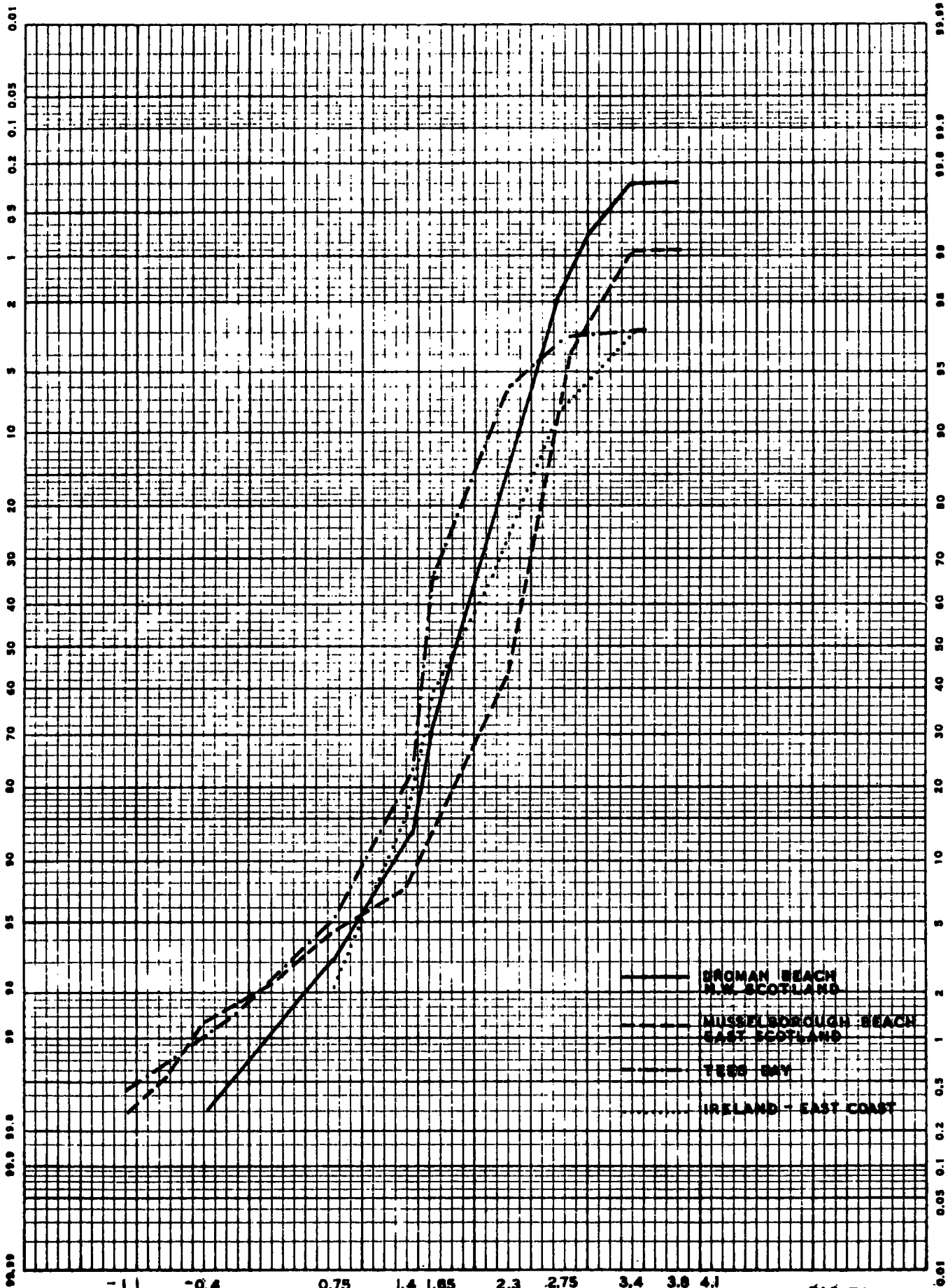


FIG. 77

BEACH SAMPLES FROM AREAS OUTSIDE THE TEES RIVER BASIN.

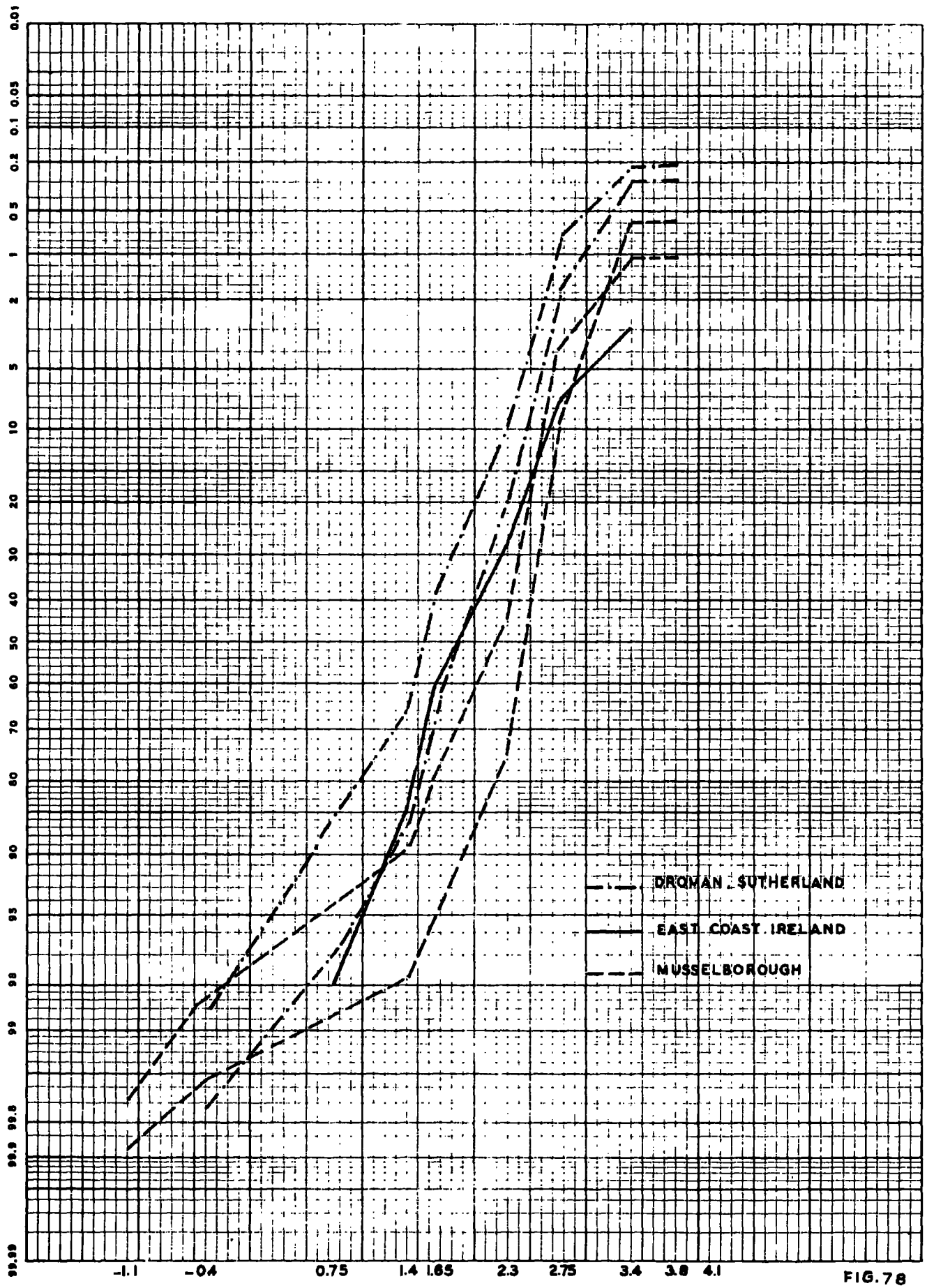


FIG. 78

DUNE SAMPLES FROM AREAS OUTSIDE THE TEES RIVER BASIN

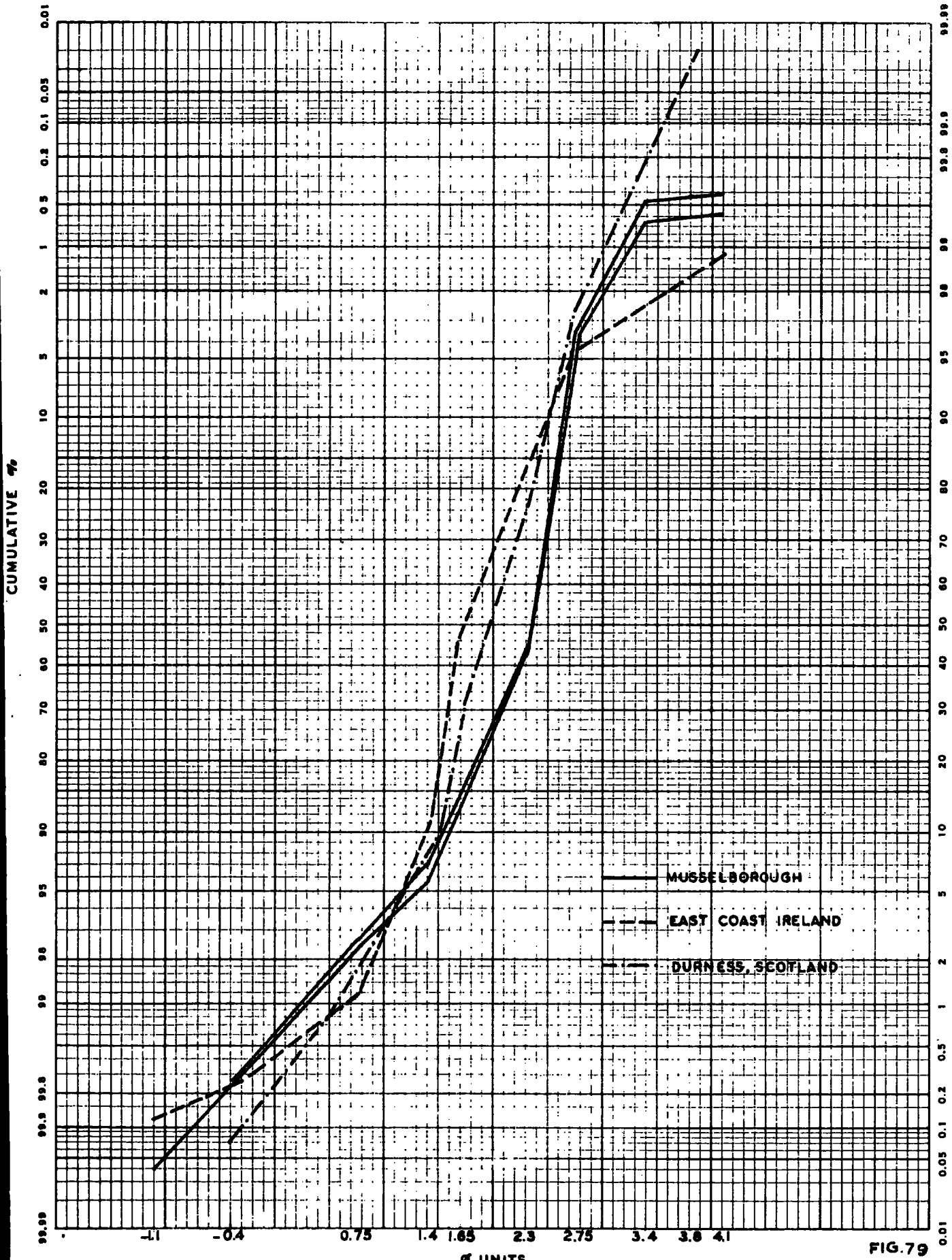


FIG. 79

RIVER SAMPLES FROM OUTSIDE THE TEES RIVER BASIN.

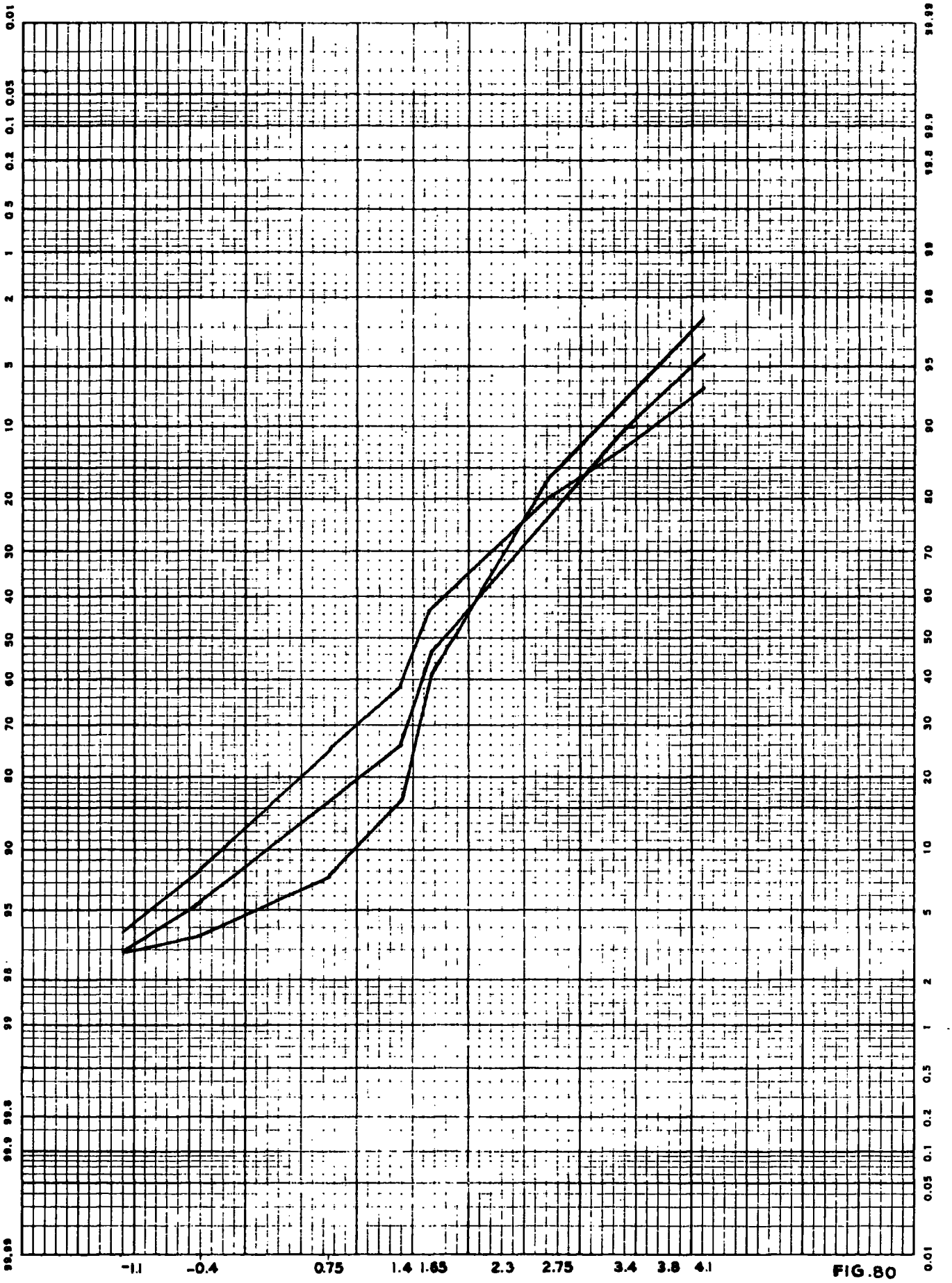


FIG.80

OFFSHORE SAMPLES FROM AREAS OUTSIDE THE RIVER TEES BASIN

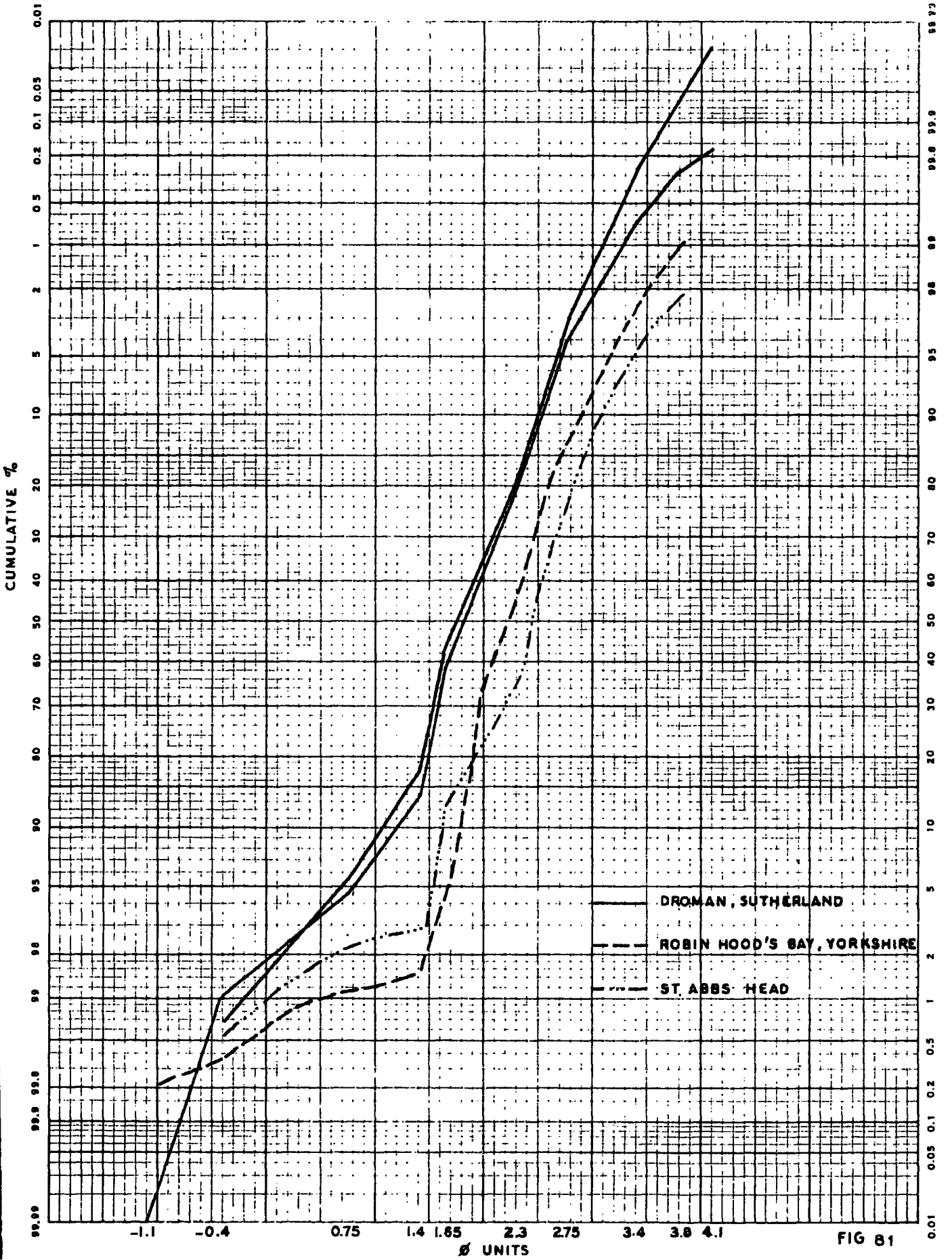


FIG 81

SAND FRACTION FROM BOULDER CLAYS IN NORTHUMBERLAND AND DURHAM.

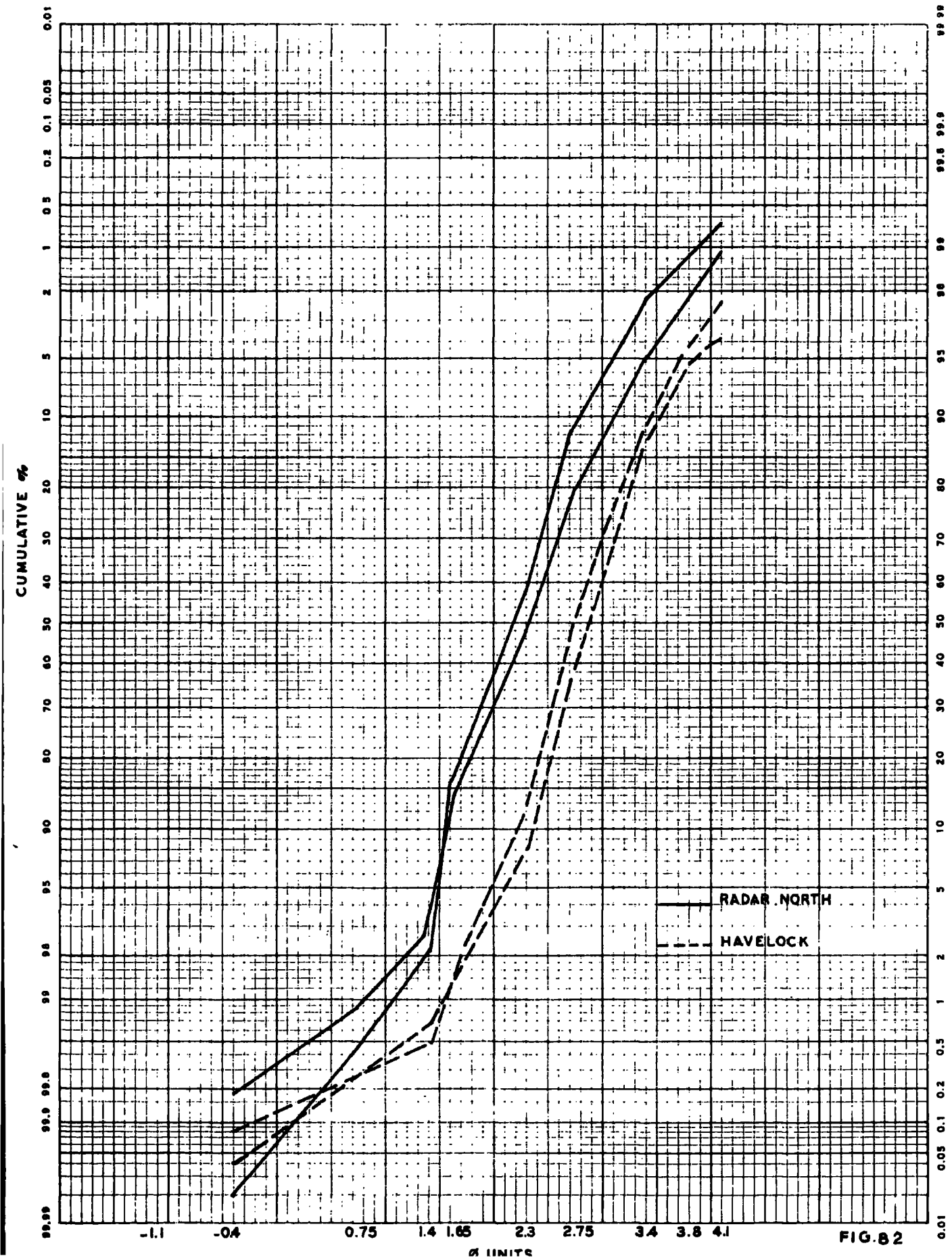


FIG. 82

FLUVIO - GLACIAL SAMPLES FROM SOUTHEAST ICELAND.

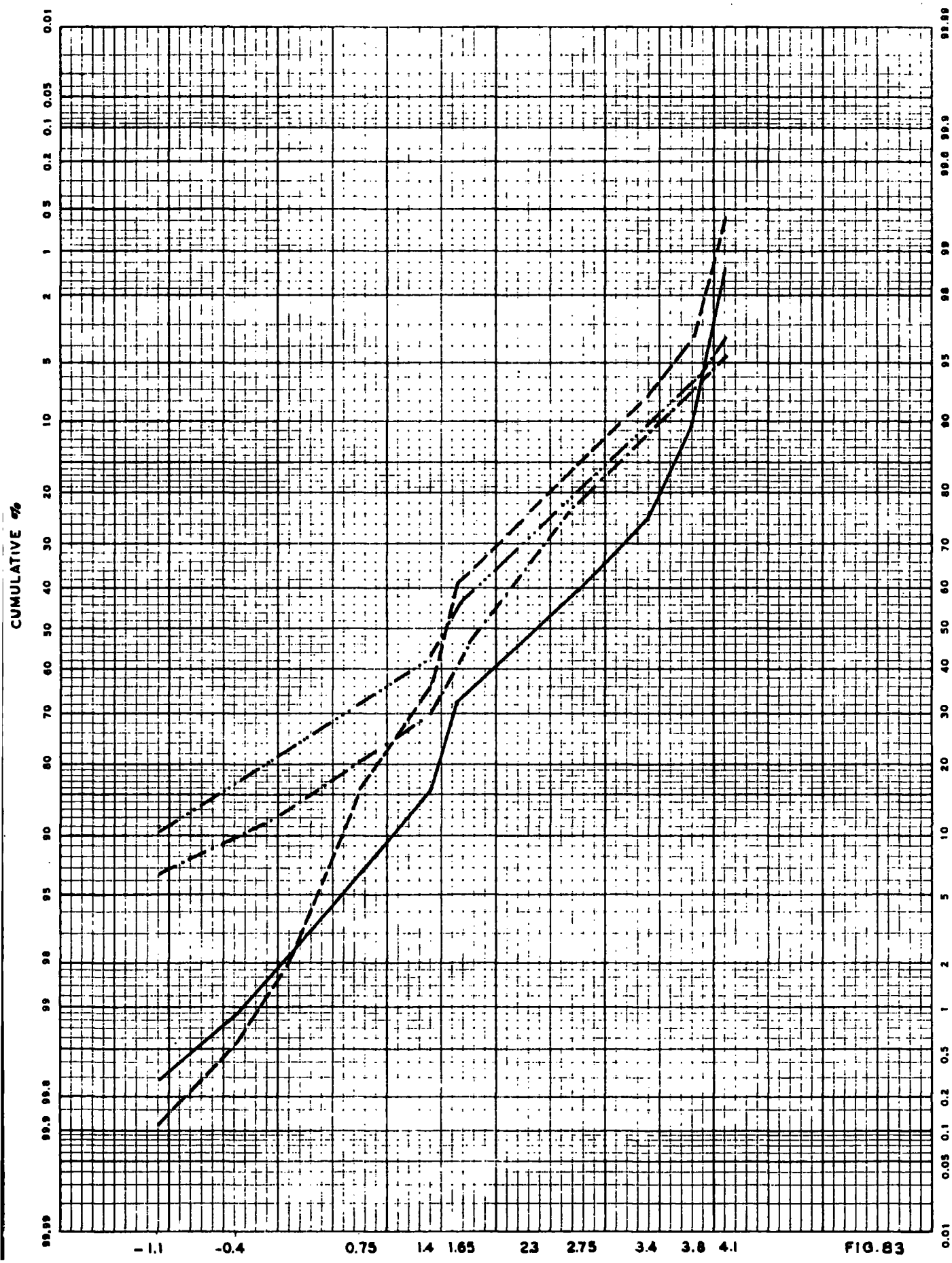


FIG. 83

TYPICAL CURVES OF THE FOUR PRESENT DAY SANDY ENVIRONMENTS IN THE TEES BASIN

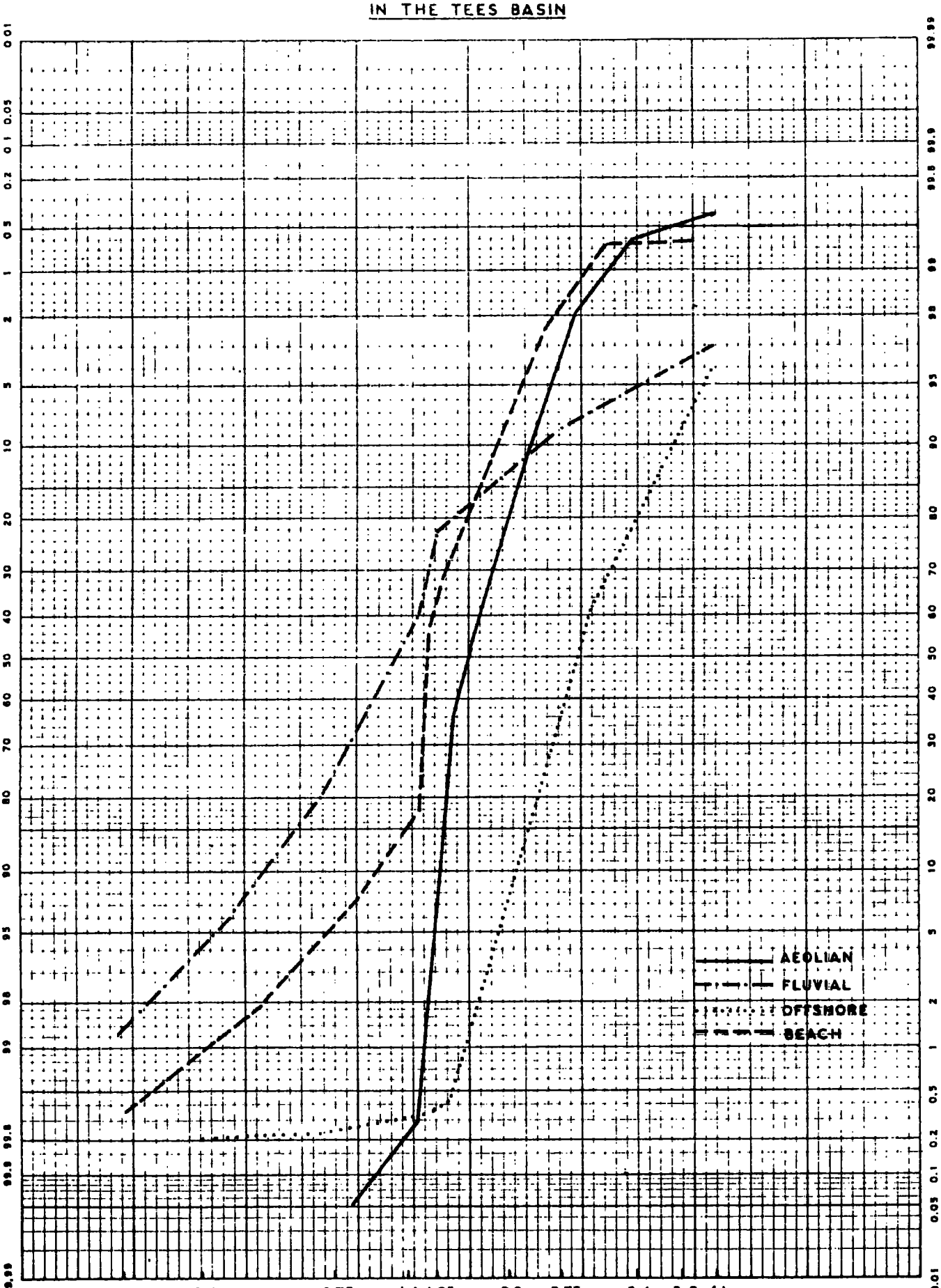
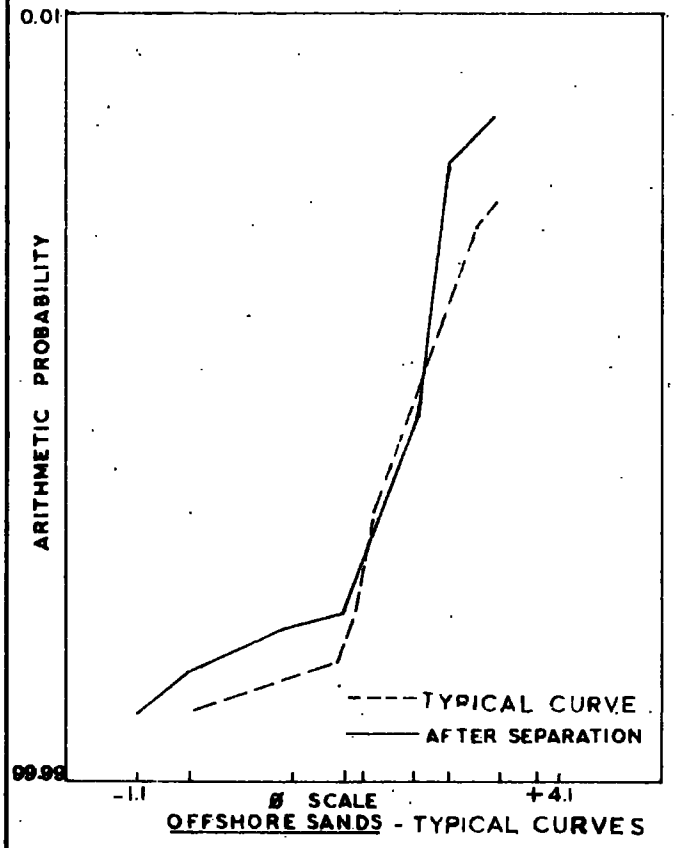
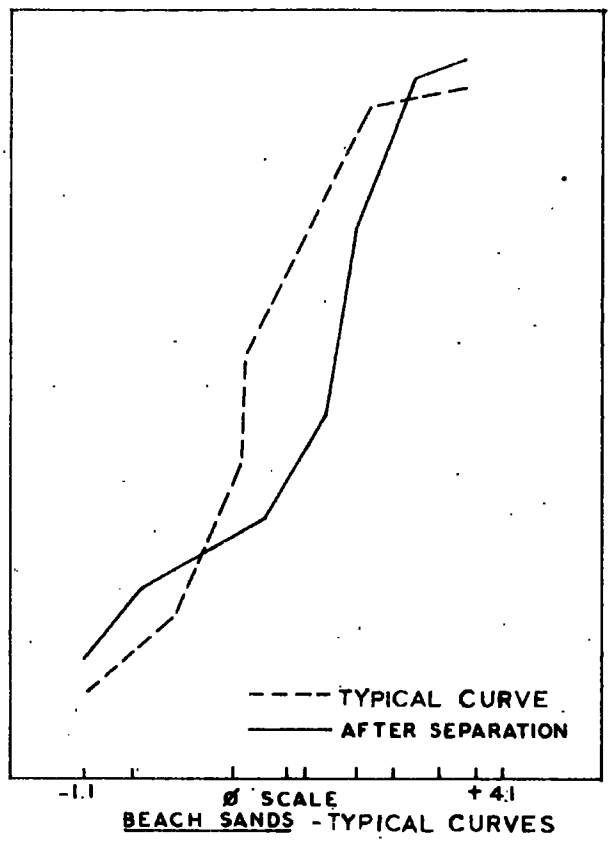


FIG. 84

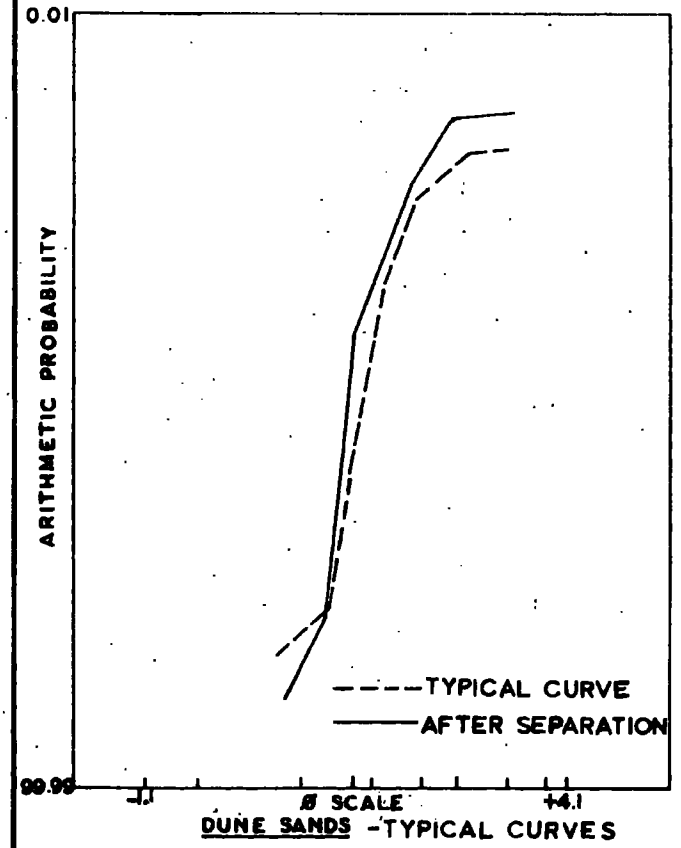
TYPICAL CURVES OF VARIOUS SANDS AFTER REMOVAL OF SHELL COAL AND HEAVY MINERALS



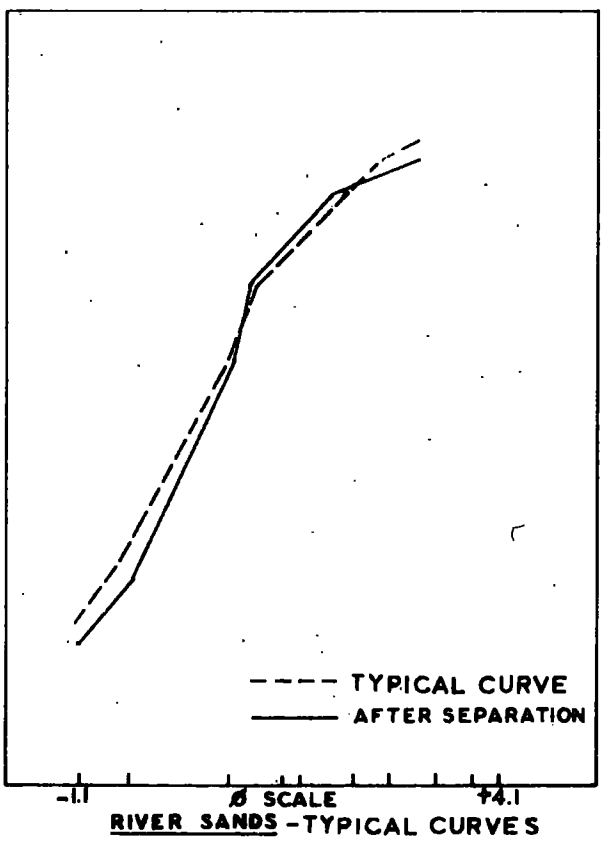
OFFSHORE SANDS - TYPICAL CURVES



BEACH SANDS - TYPICAL CURVES



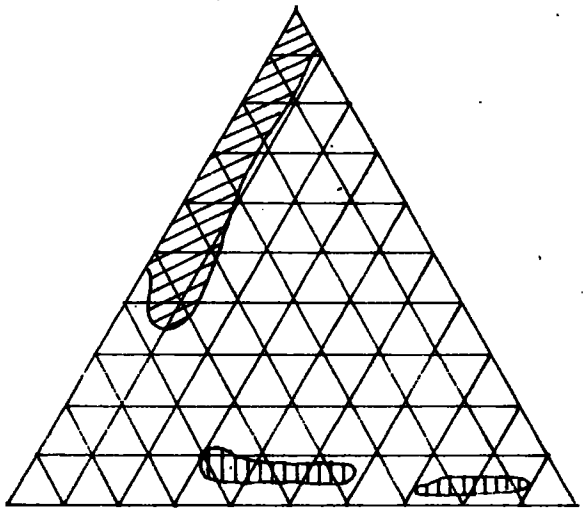
DUNE SANDS - TYPICAL CURVES



RIVER SANDS - TYPICAL CURVES

FIG. 85

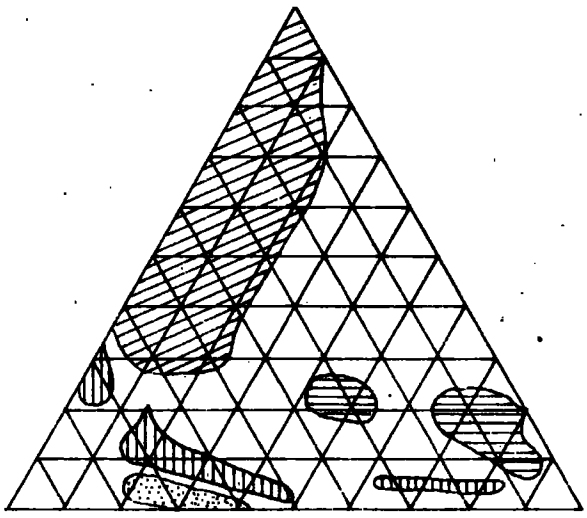
FACTOR LOADING RATIOS OF KNOWN AND UNKNOWN ENVIRONMENTS



LAKESHORE

LAKE NEAR SHORE

LACUSTRINE ENVIRONMENT



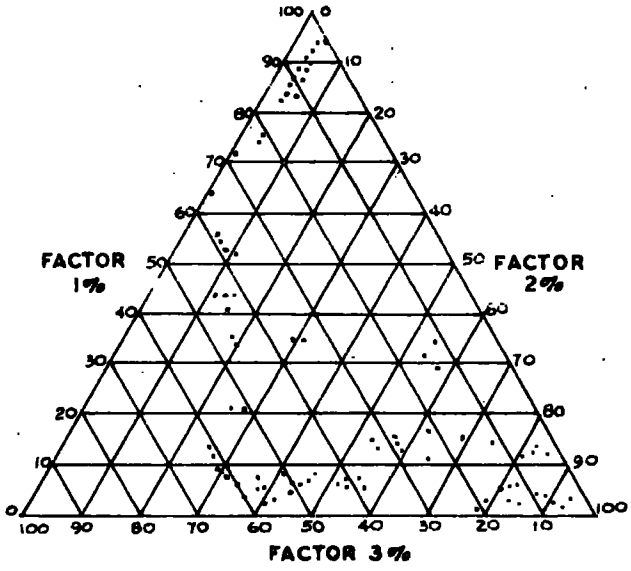
OFFSHORE 78% SUCCESSFUL

DUNE 86% "

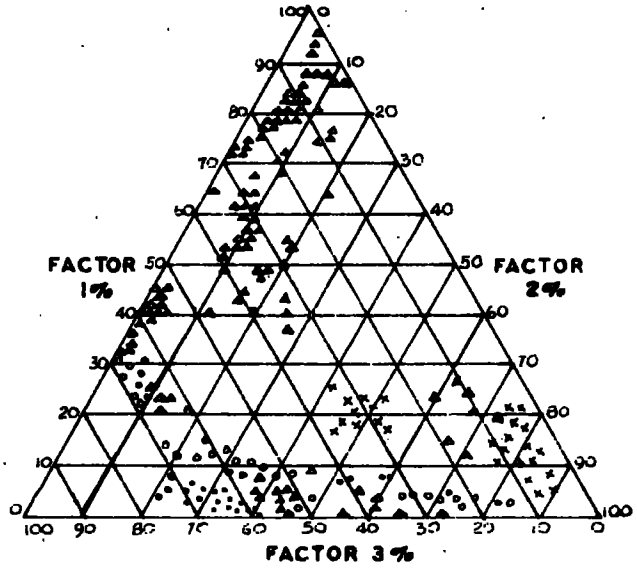
RIVER 100% "

BEACH 100% "

ENVIRONMENTAL ZONES



DISTRIBUTION OF SAMPLES OF UNKNOWN ORIGIN.



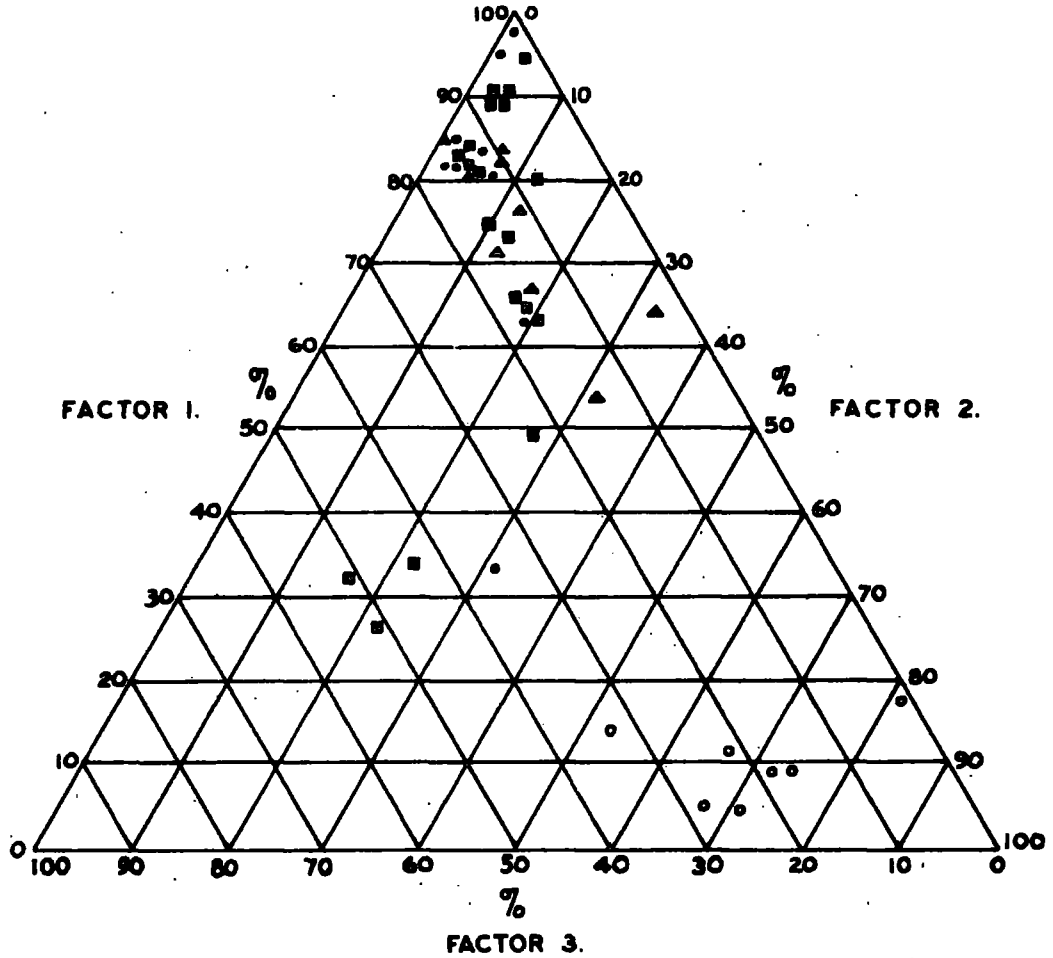
● DUNE
o BEACH
× RIVER
▲ OFFSHORE

DIFFERENTIATION OF ENVIRONMENTS USING FACTOR RATIOS BASED ON PARTICLE SIZE

FIG. 86

FACTOR LOADINGS OF KNOWN SAMPLES

(BASED ON ALL SEDIMENTARY DATA)

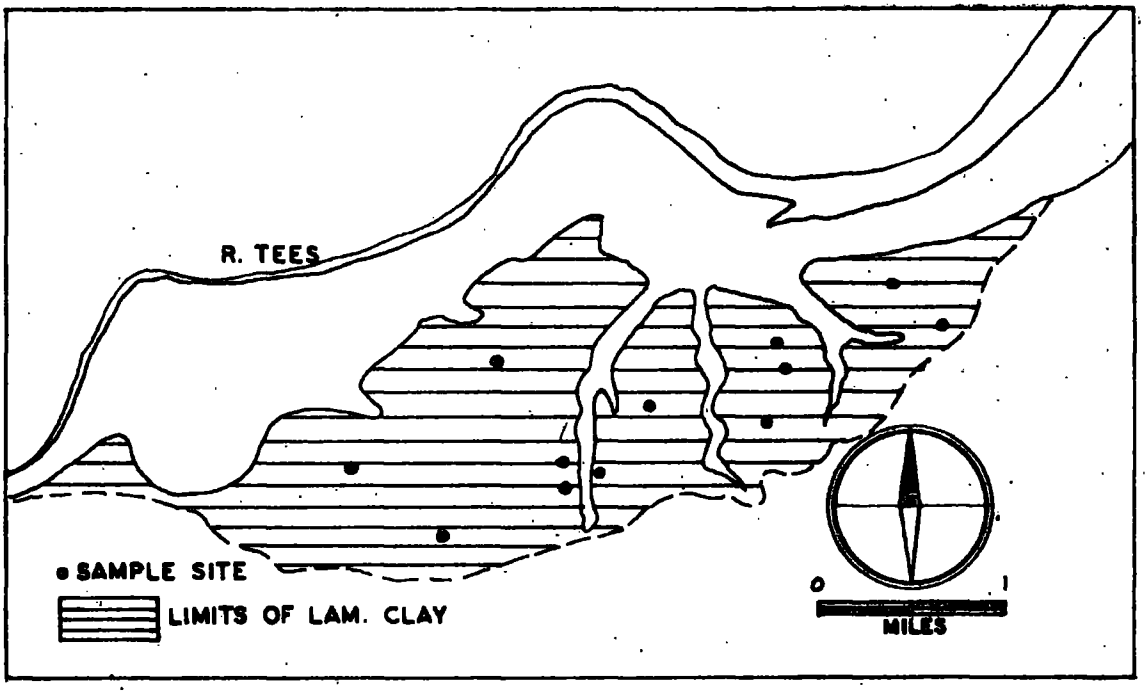


- BEACH
- DUNE
- RIVER
- OFFSHORE

FIG. 87

PERCENTAGE SILT CONTENT OF THE TEES LAMINATED CLAY DEPOSITS.

(A.)



(B.)

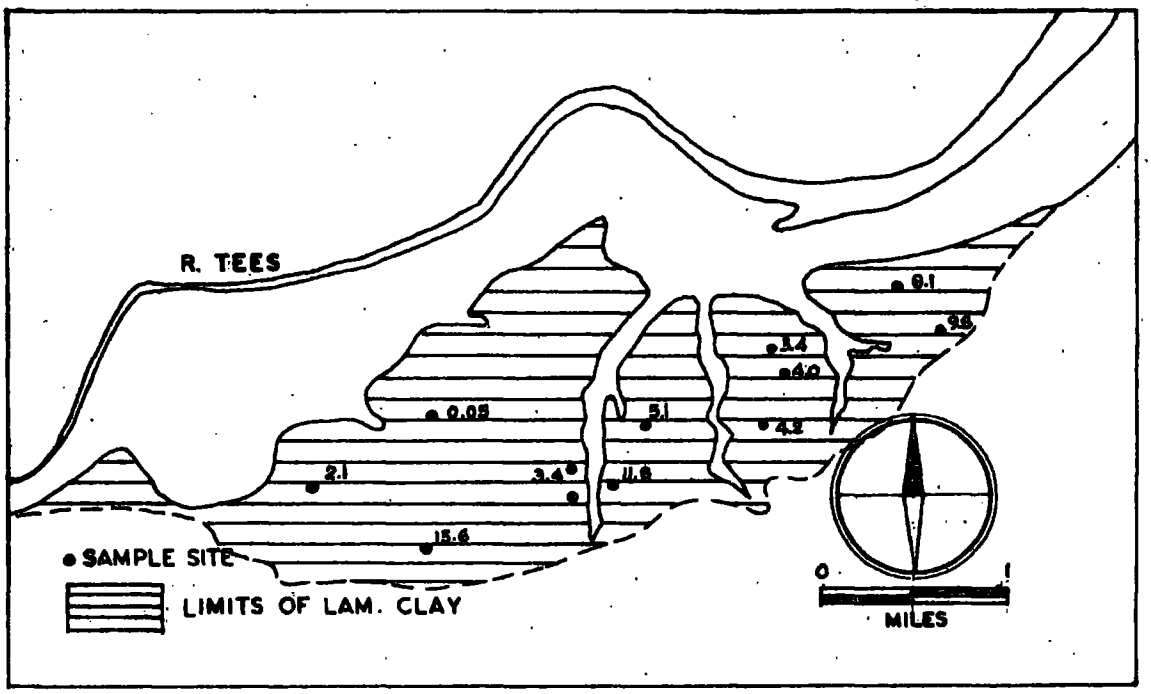
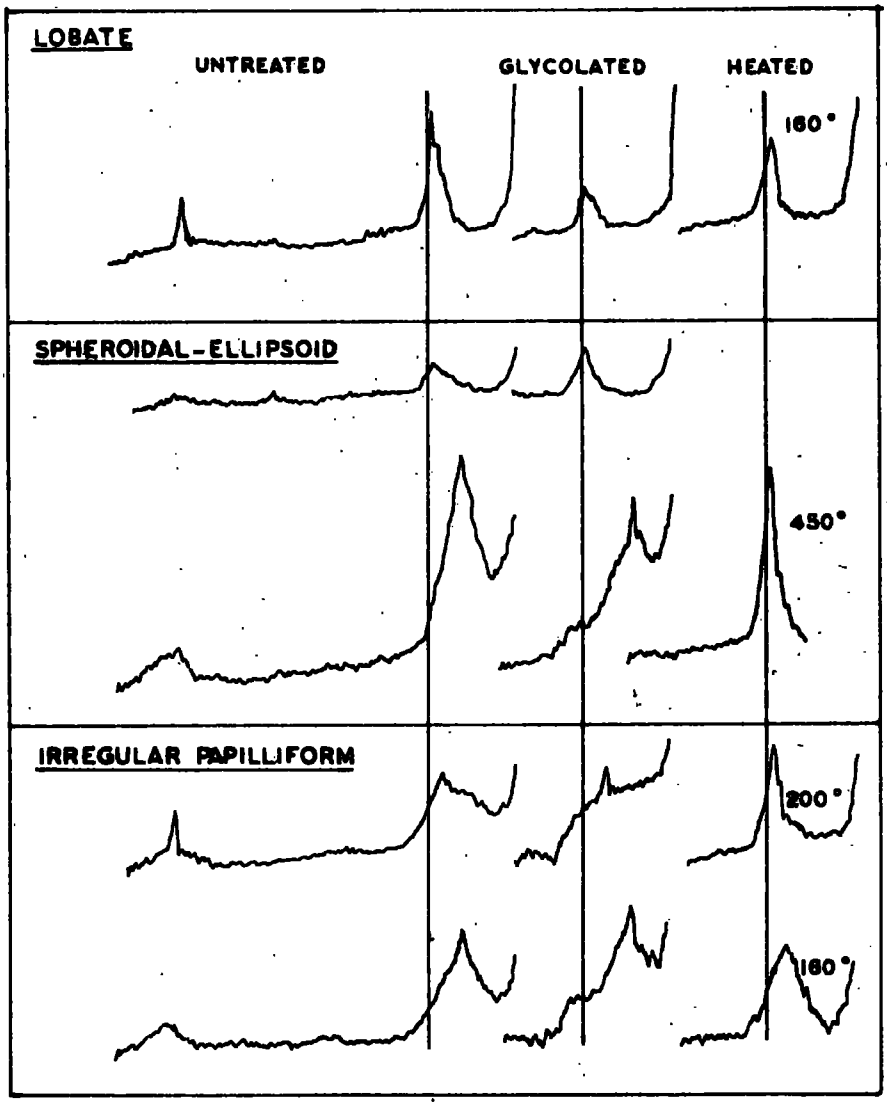


FIG.88

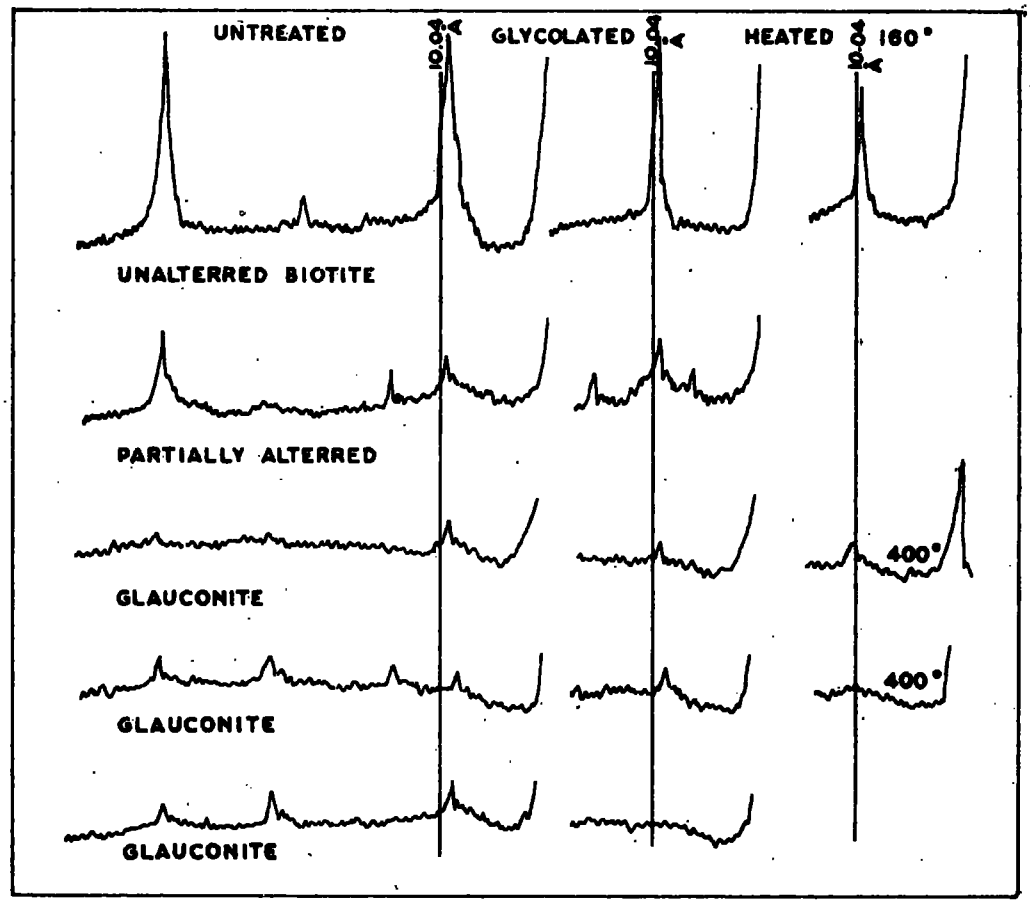
X-RAY DIFFRACTOMETER PATTERNS OF LOBATE, SPHEROIDAL-ELLIPSOID AND IRREGULAR-PAPILLIFORM GLAUCONITE GRAINS.



AFTER PRATT 1962.

FIG. 89

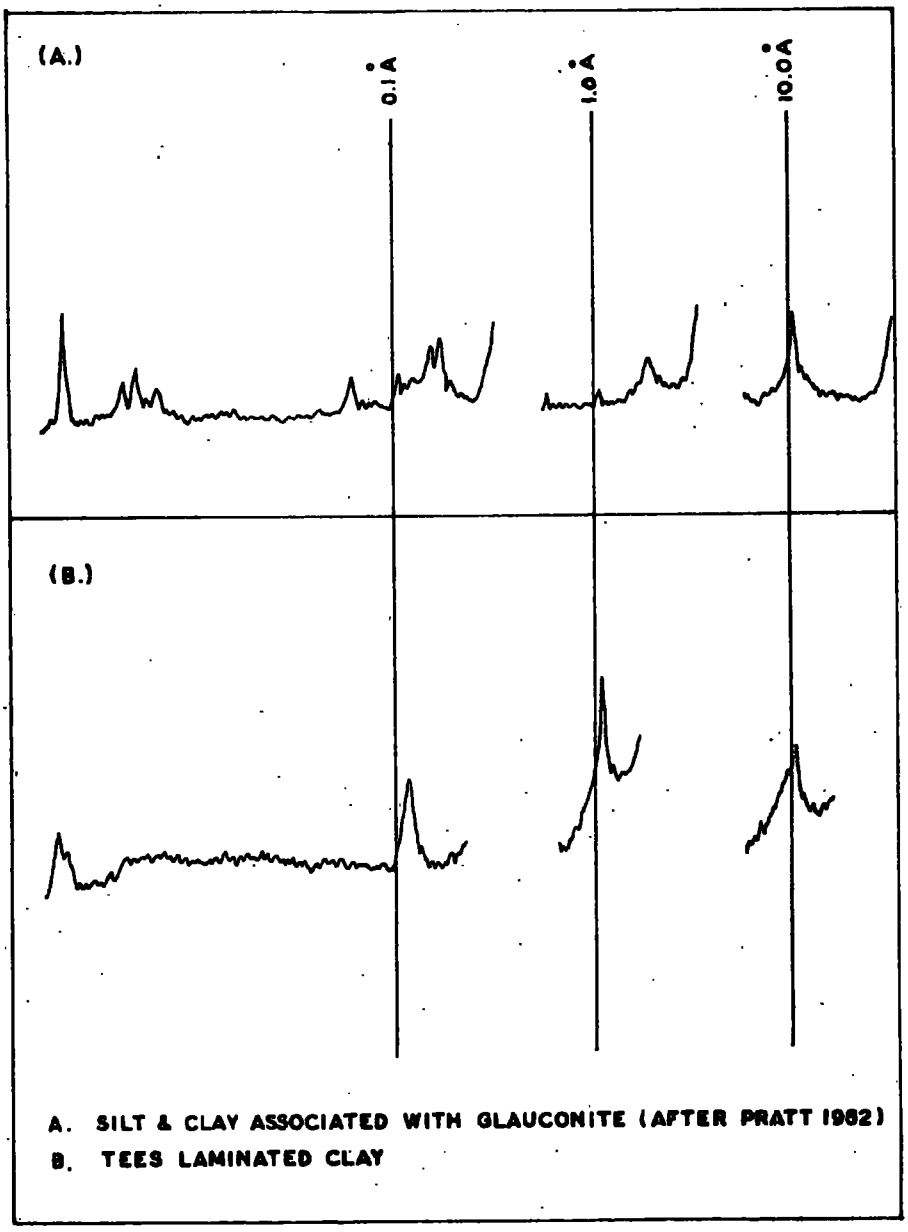
X-RAY DIFFRACTION PATTERNS OF BIOTITE AND GLAUCONITE



AFTER PRATT 1962.

FIG: 90

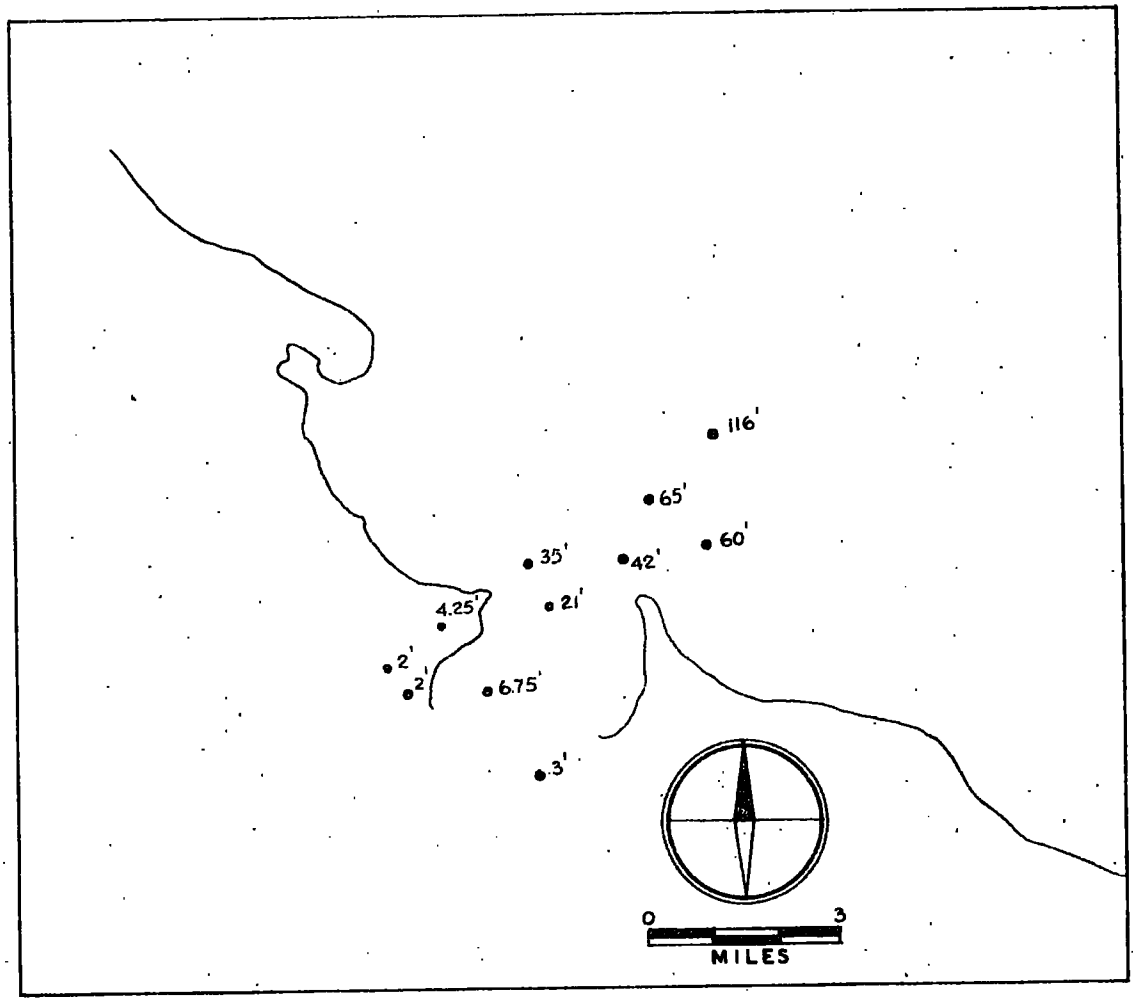
COMPARISON OF GLAUCONITE CONTAINING DEPOSIT WITH THE TEES LAMINATED CLAY.



A. SILT & CLAY ASSOCIATED WITH GLAUCONITE (AFTER PRATT 1962)
B. TEES LAMINATED CLAY

FIG. 91

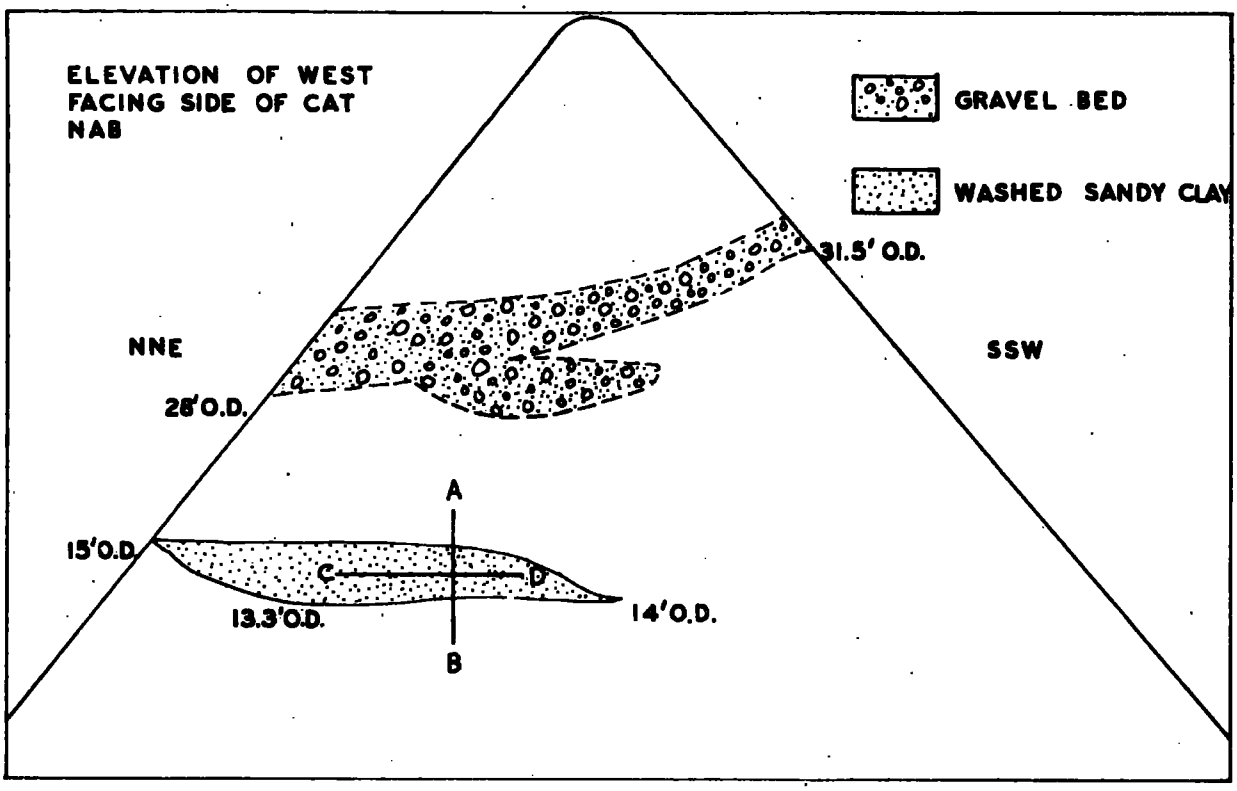
LOCATION OF BOREHOLES RECORDING LAMINATED CLAY AT DEPTHS BELOW ORDNANCE DATUM.



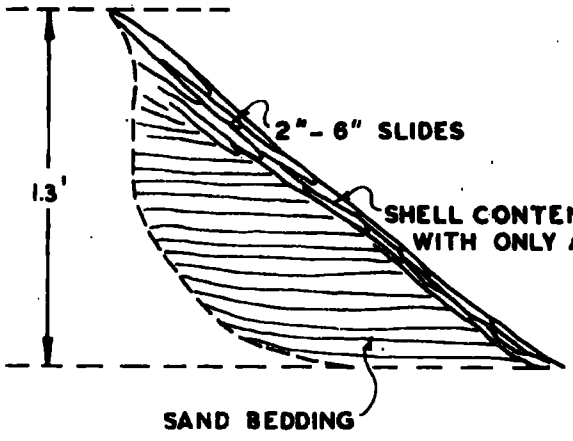
• 2' INDICATES DEPTH OF LAMINATED CLAY SURFACE

FIG. 92

SUPPOSED MARINE DEPOSIT RECORDED AT SALTBURN BEACH.



SECTION A – B



SECTION C – D

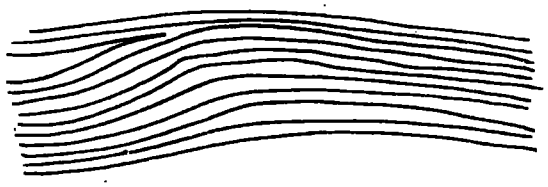


FIG. 93

PARTICLE SIZE CURVES OF THE SUPPOSED MARINE SAND AT SALTBURN

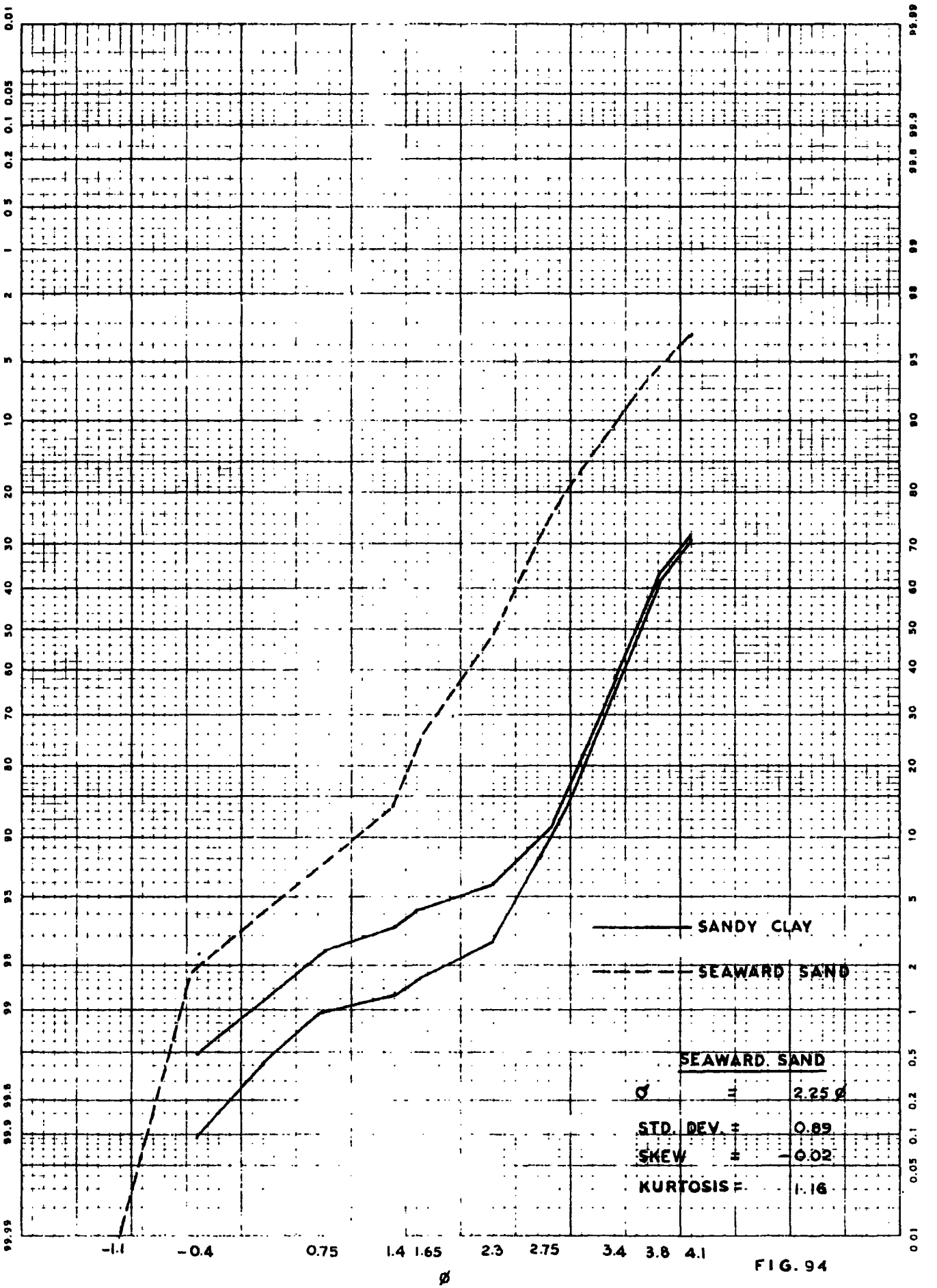
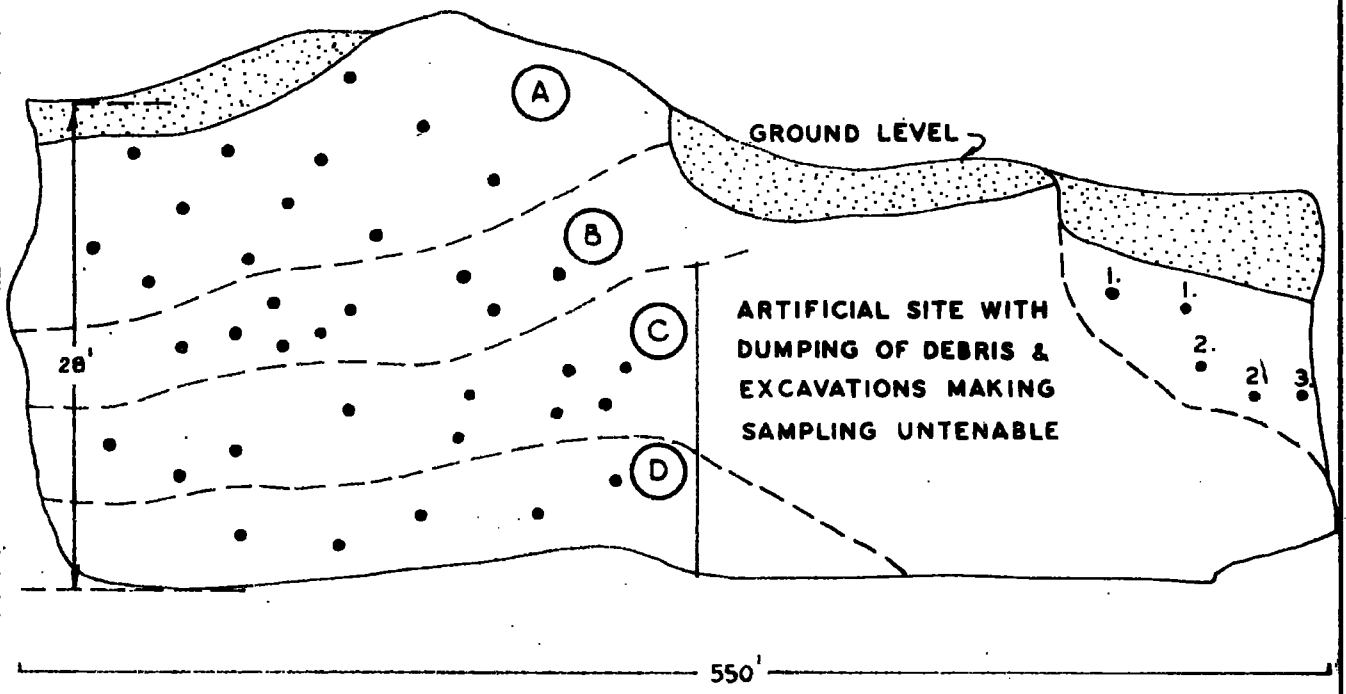


FIG. 94

BRIERTON SAND DEPOSIT, WEST HARTLEPOOL (477299)

LOCATION OF SAMPLES

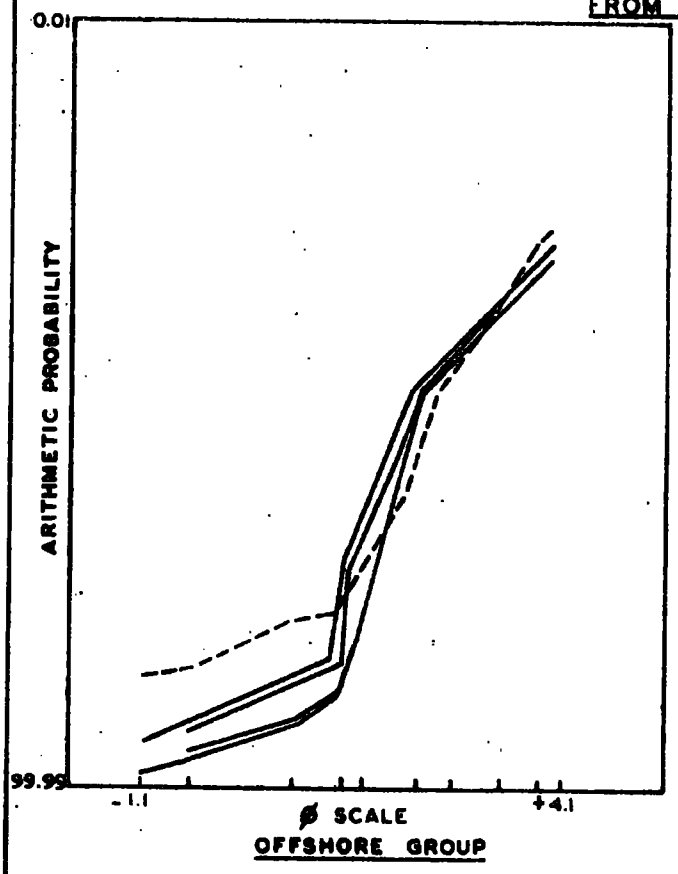


ELEVATION

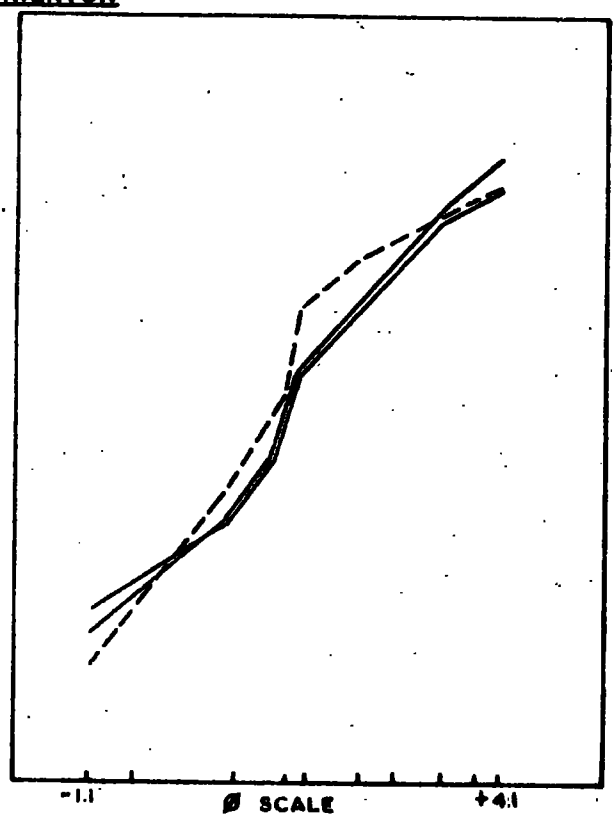
CLAY DEPOSIT

FIG. 95

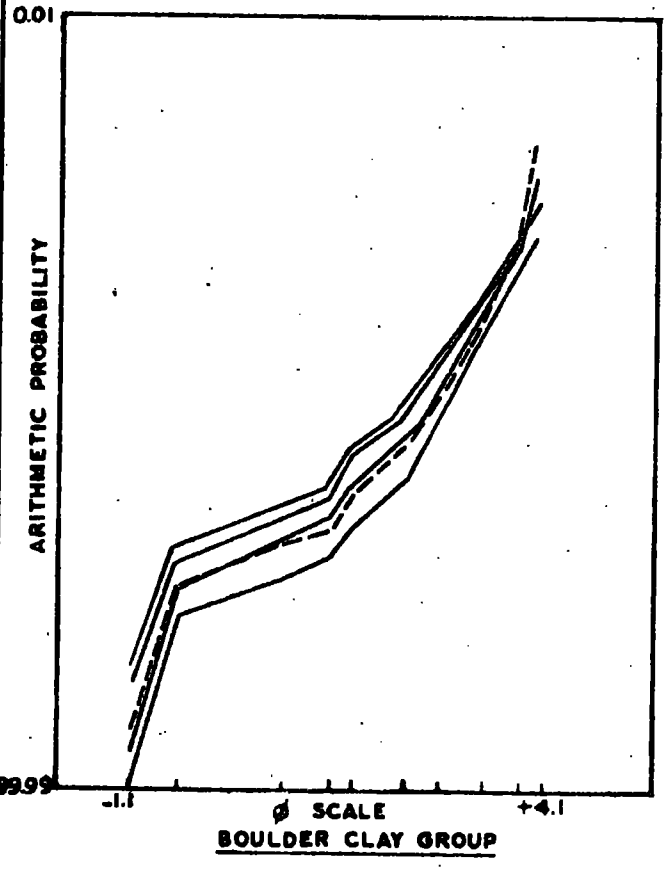
GRAPH SHOWING PARTICLE SIZE CURVES OF SAMPLES FROM BRIERTON



OFFSHORE GROUP



FLUVIAL GROUP



BOULDER CLAY GROUP

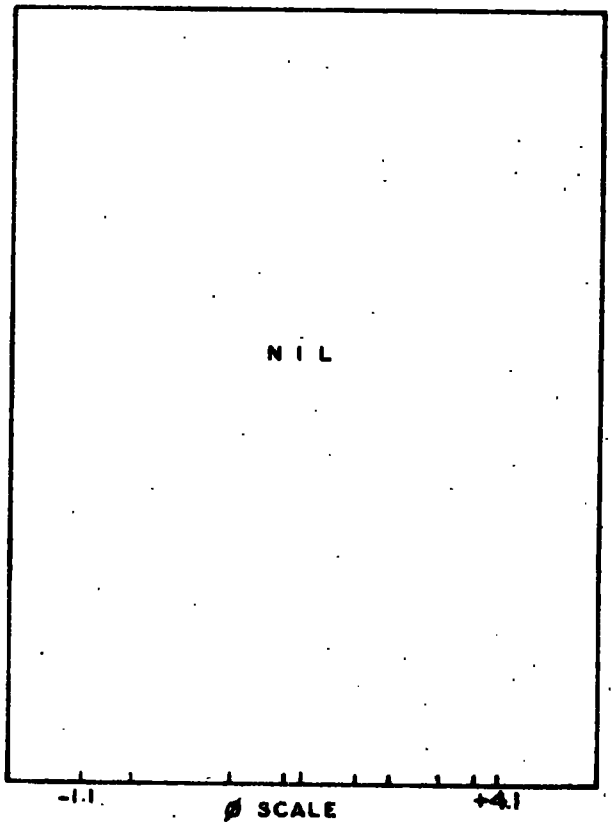


FIG. 96

PARTICLE SIZE CURVES OF SAMPLES FROM ESTON CEMETERY & PARKEND FARM

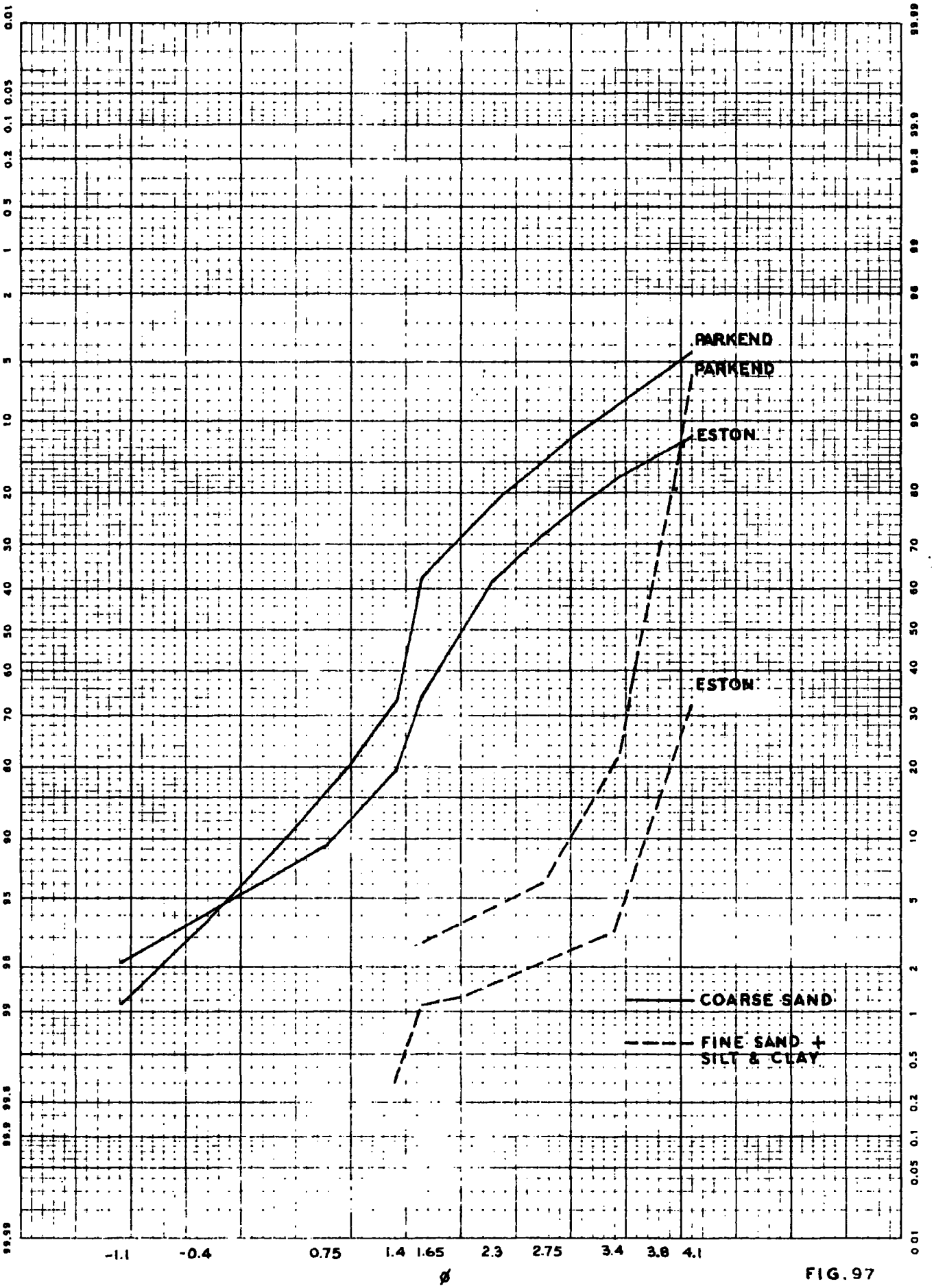


FIG. 97

PARTICLE SIZE CURVES OF SAND SAMPLES FROM THE ORMESBY BECK VALLEY

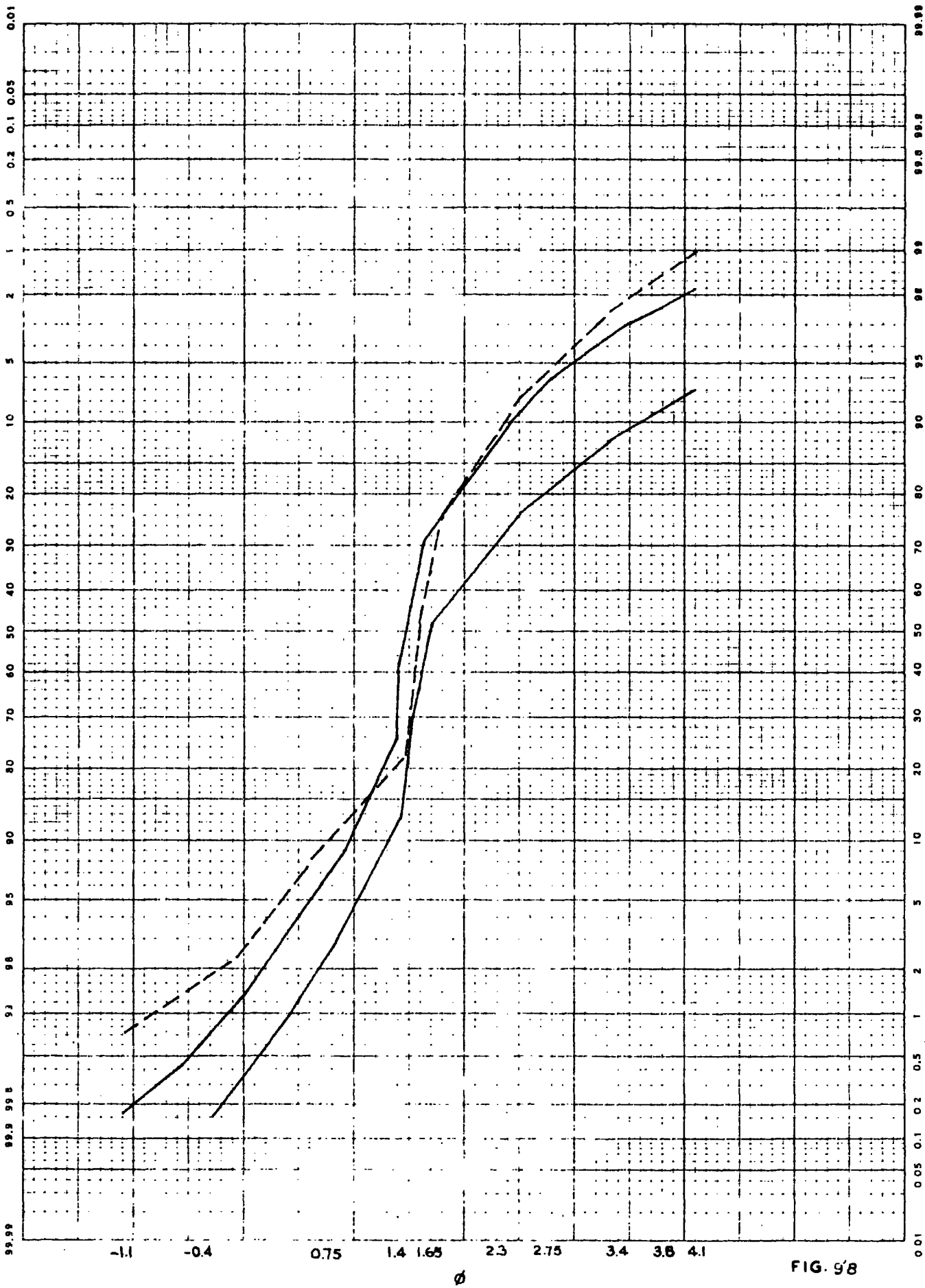
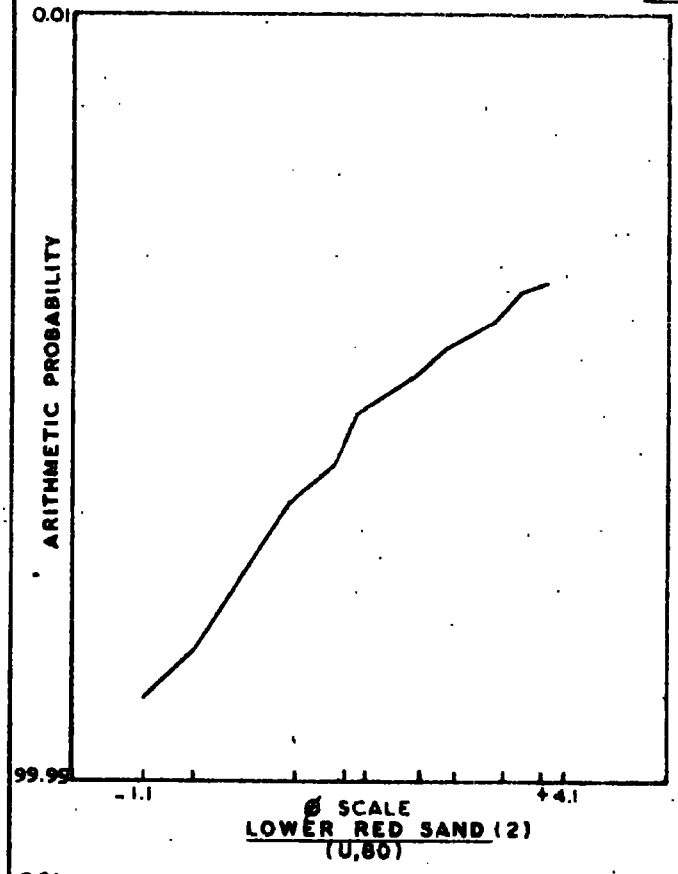
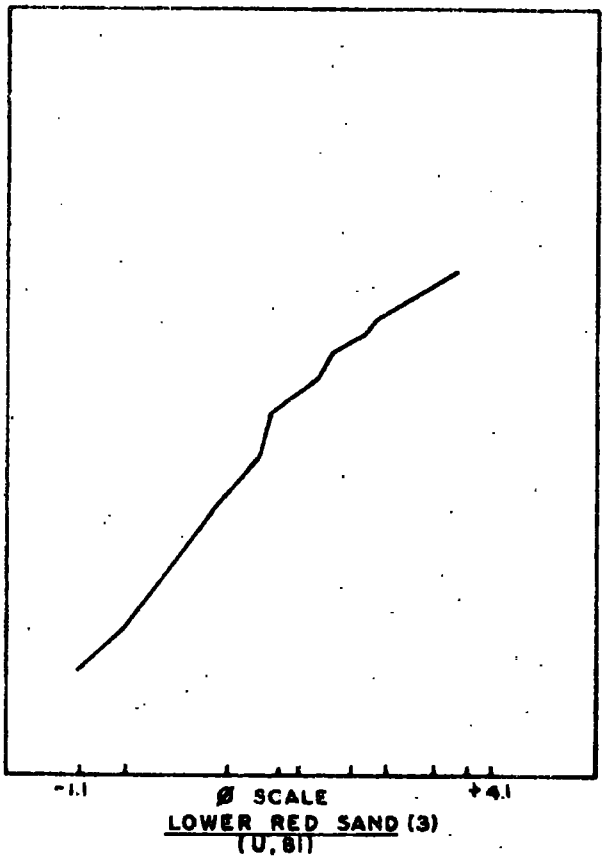


FIG. 9'8

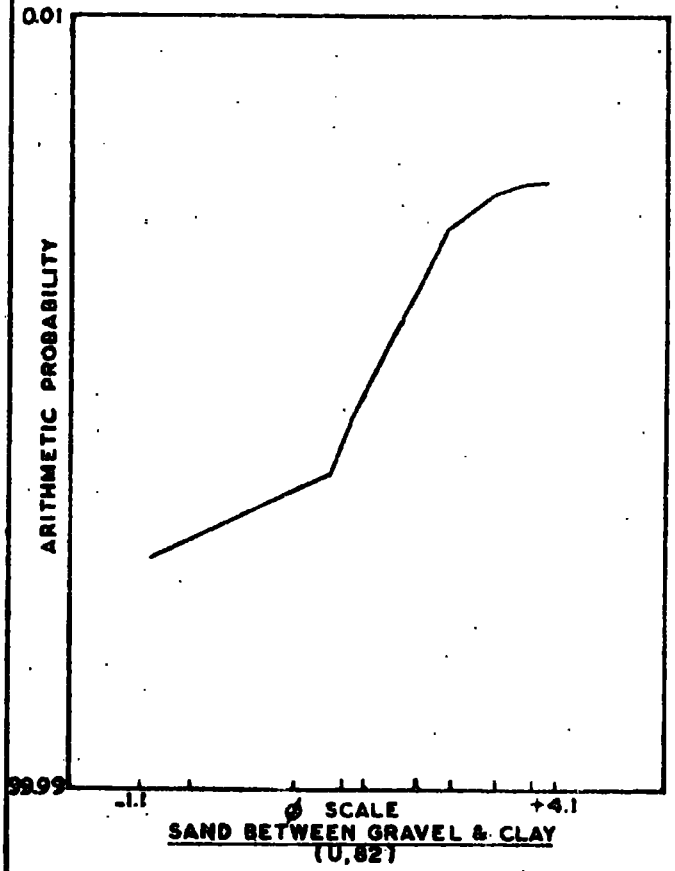
FOUR PARTICLE SIZE CURVES FROM NEWTON BEWLEY SAND SAMPLES.



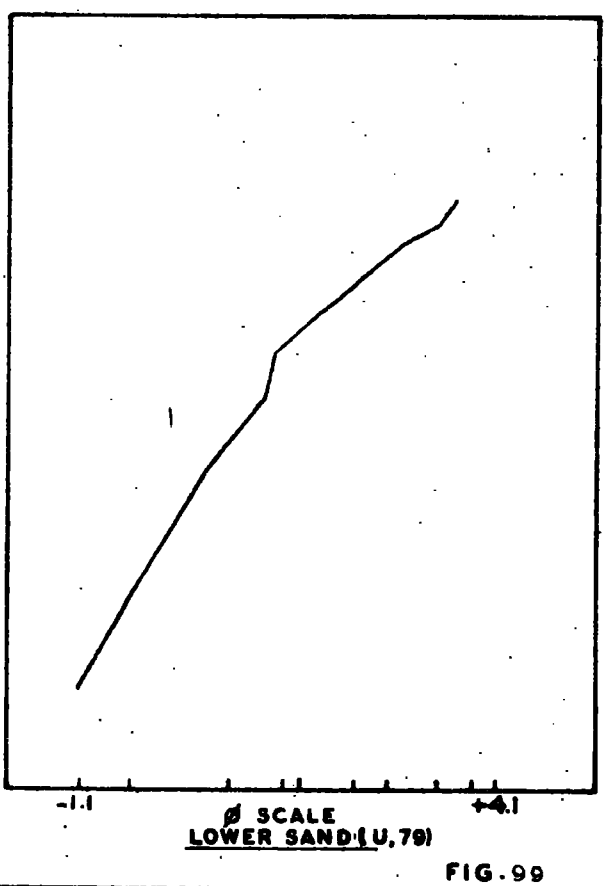
LOWER RED SAND (2)
(U,80)



LOWER RED SAND (3)
(U,81)



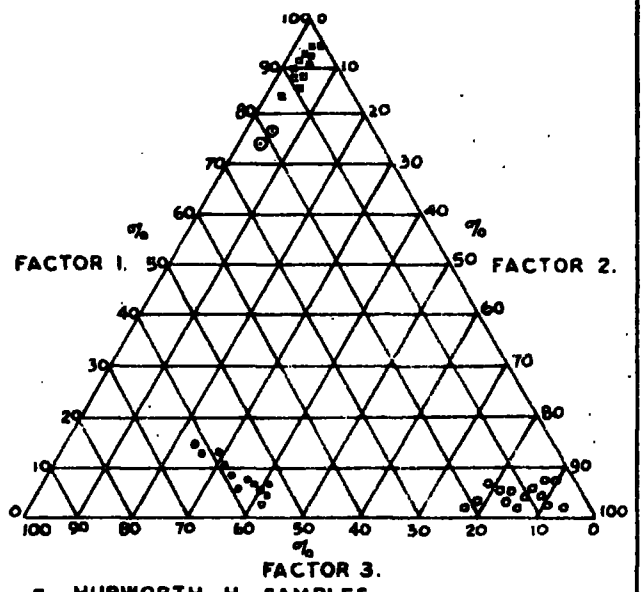
SAND BETWEEN GRAVEL & CLAY
(U,82)



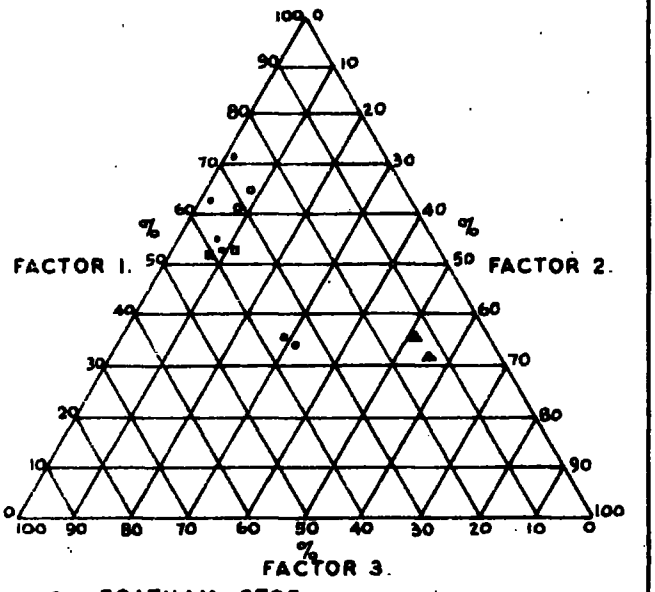
LOWER SAND (U,79)

FIG. 99

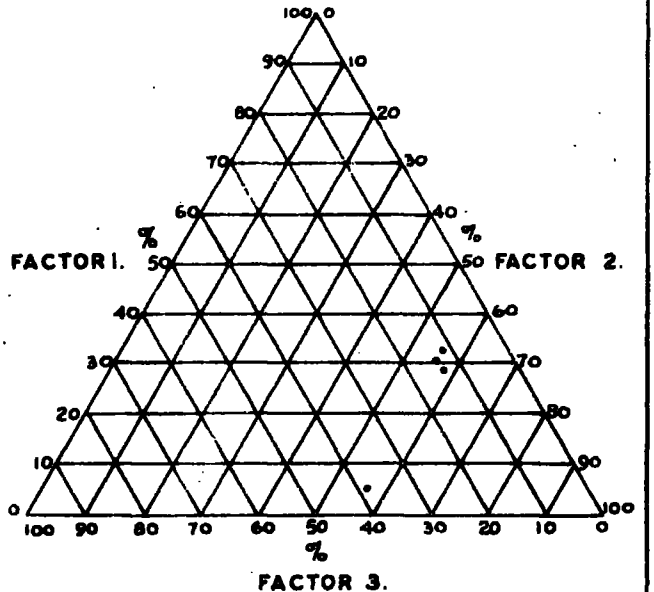
FACTOR LOADINGS BASED ON PARTICLE SIZE ANALYSIS.



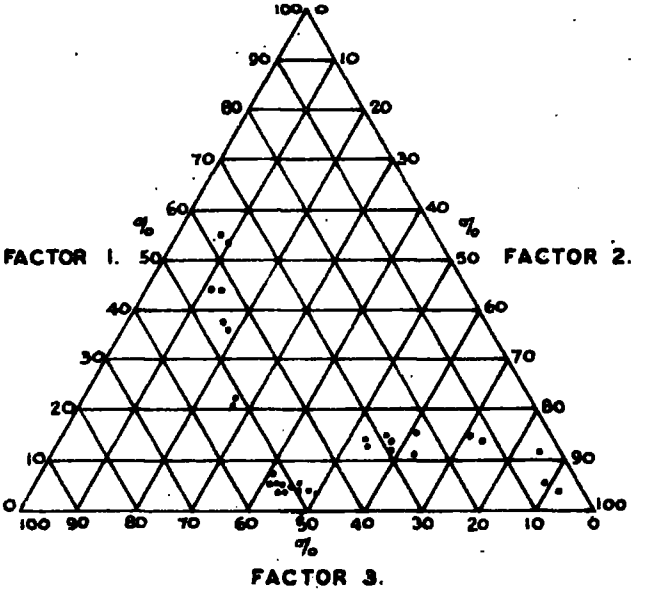
- ■ HURWORTH H. SAMPLES
- • HURWORTH
- o WYNYARD
- ⊙ WYNYARD BASAL SAND



- • COATHAM STOB
- ▲ SANDY FLAT
- o SPITTAL FLAT
- ■ CAT FLAT



NEWTON BEWLEY SAND & GRAVEL PIT



WEST HARTLEPOOL (BRIERTON - NZ 477299)

FIG. 100

PARTICLE SIZE CURVES OF SUPPOSED RAISED MARINE SAND AT HUNTCLIFF (NZ 692218)

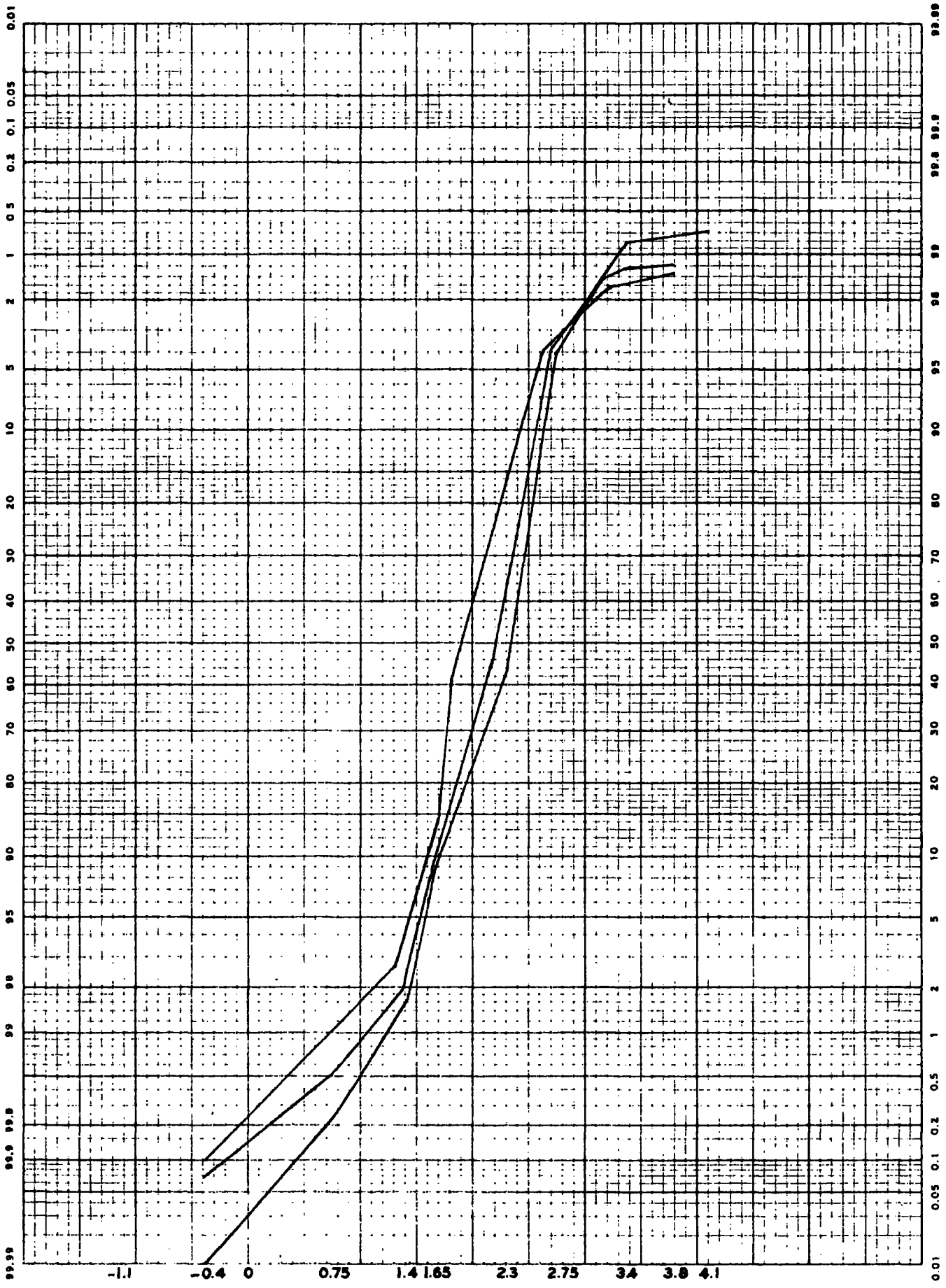


FIG. 101

PARTICLE SIZE CURVES OF SAMPLES TAKEN FROM SANDY FLAT (NZ 493158)

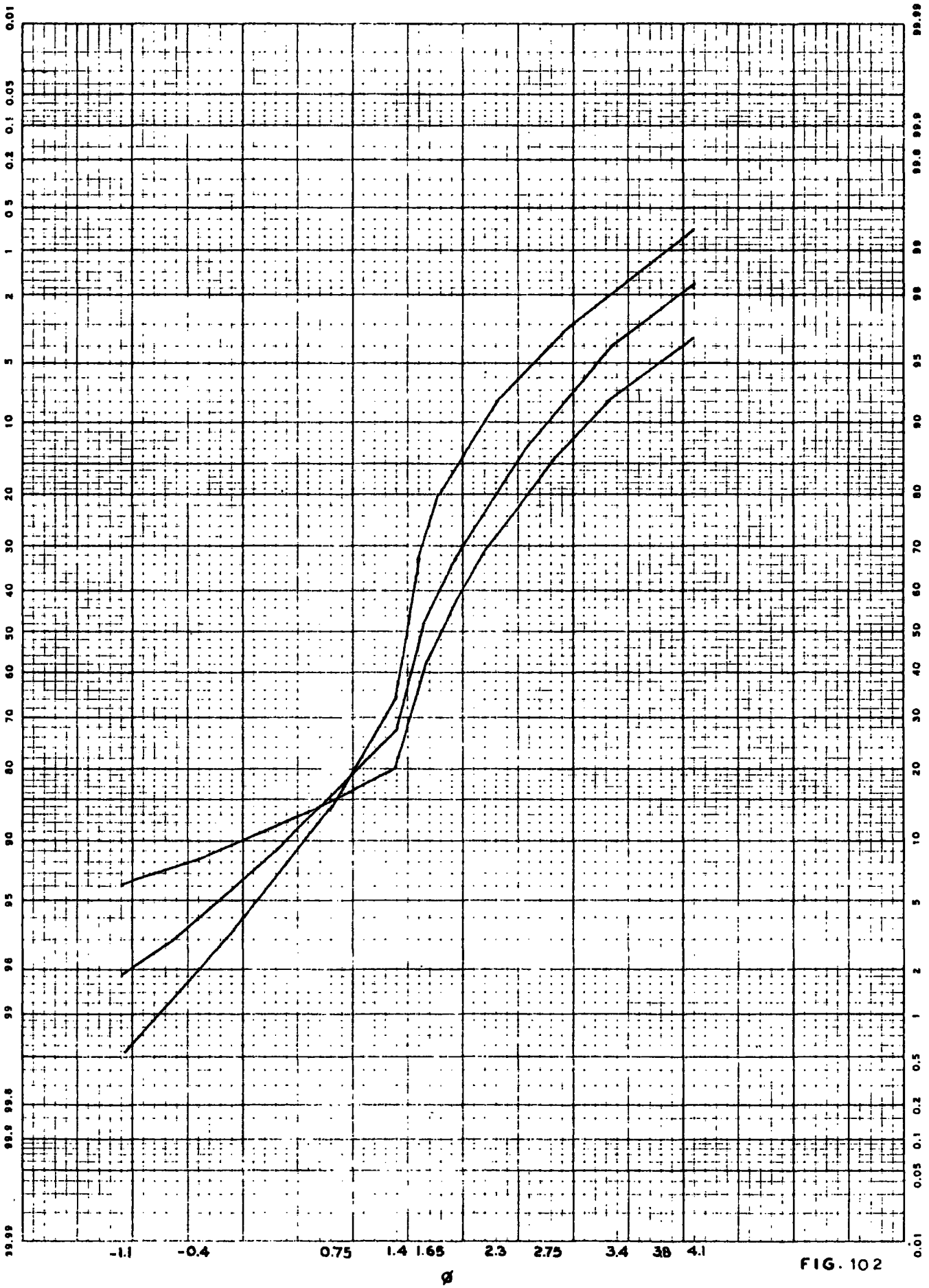


FIG. 102

PARTICLE SIZE CURVES OF SAND SAMPLES FROM LEVELLED TERRACES IN THE TEES BASIN.

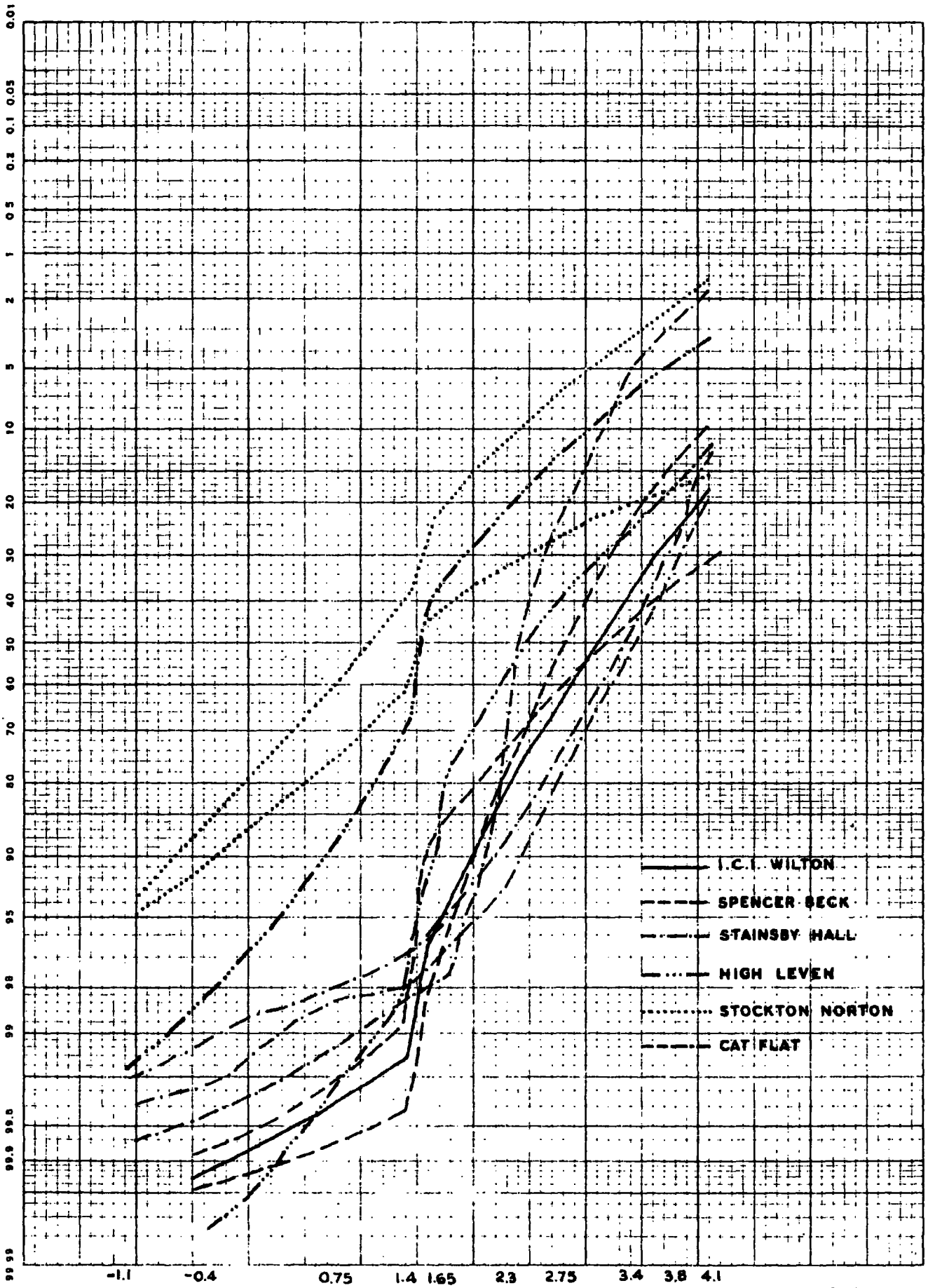


FIG.103

LOCATION OF SAMPLE POINTS FOR THE COLLECTION OF SAND SAMPLES FROM COATHAM STOB.

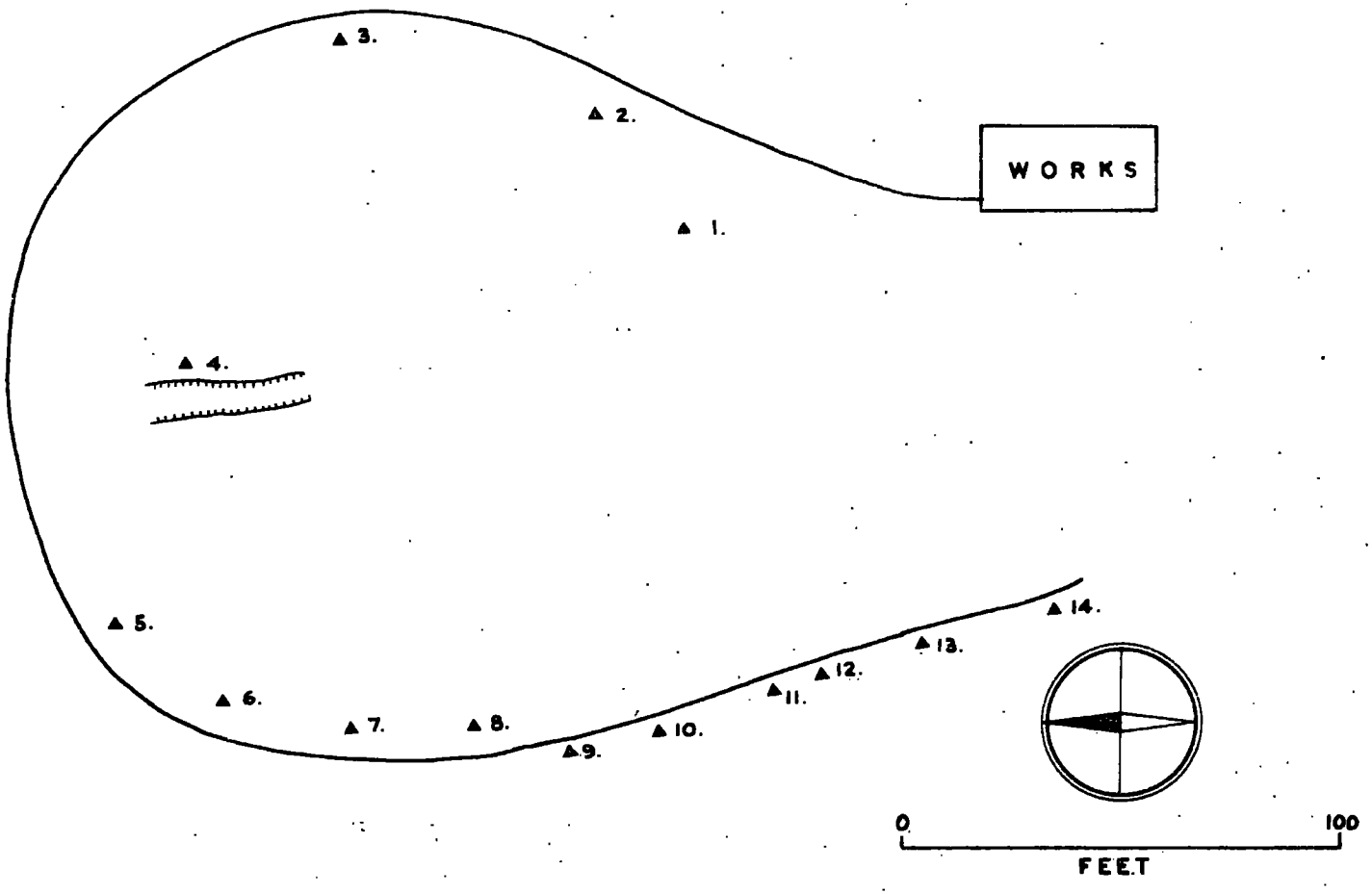


FIG.104

TYPICAL PARTICLE SIZE CURVES OF SAMPLES FROM COATHAM STOB

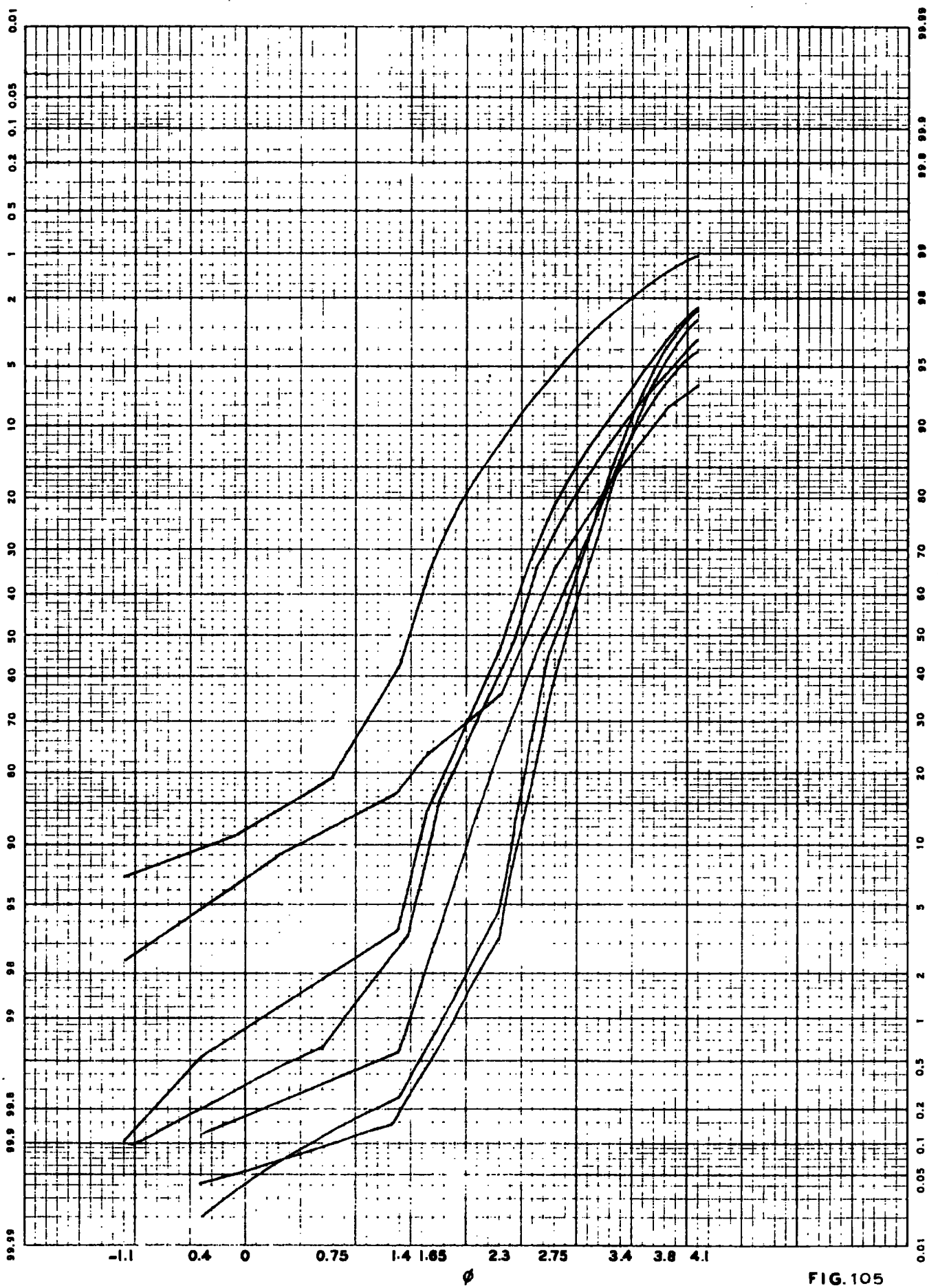


FIG. 105

TYPICAL PARTICLE SIZE CURVES OF SAMPLES FROM HURWORTH BRICK PIT.

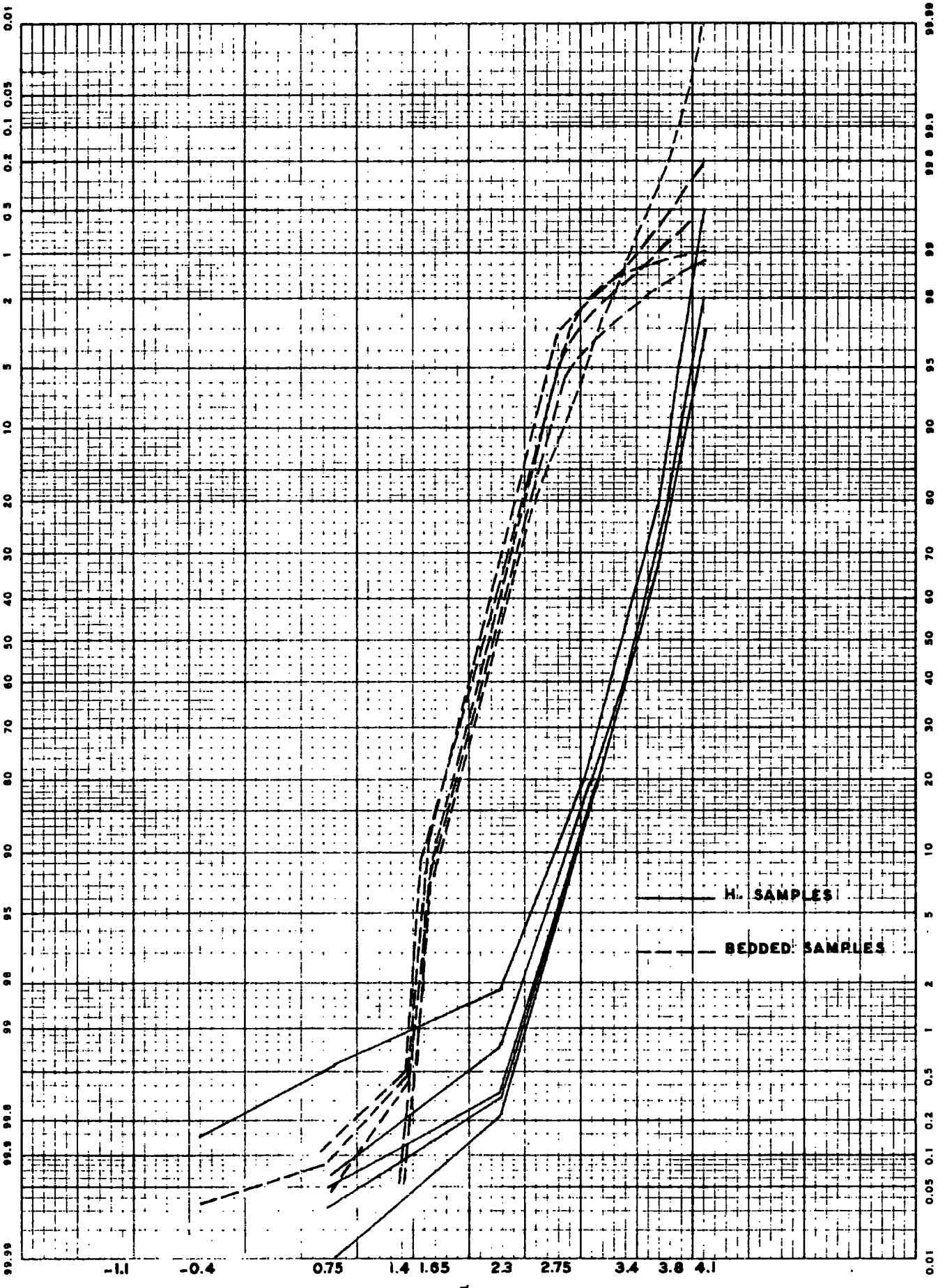


FIG. 106

TYPICAL PARTICLE SIZE CURVES OF SAMPLES FROM WYNYARD SAND PIT (NZ 415246)

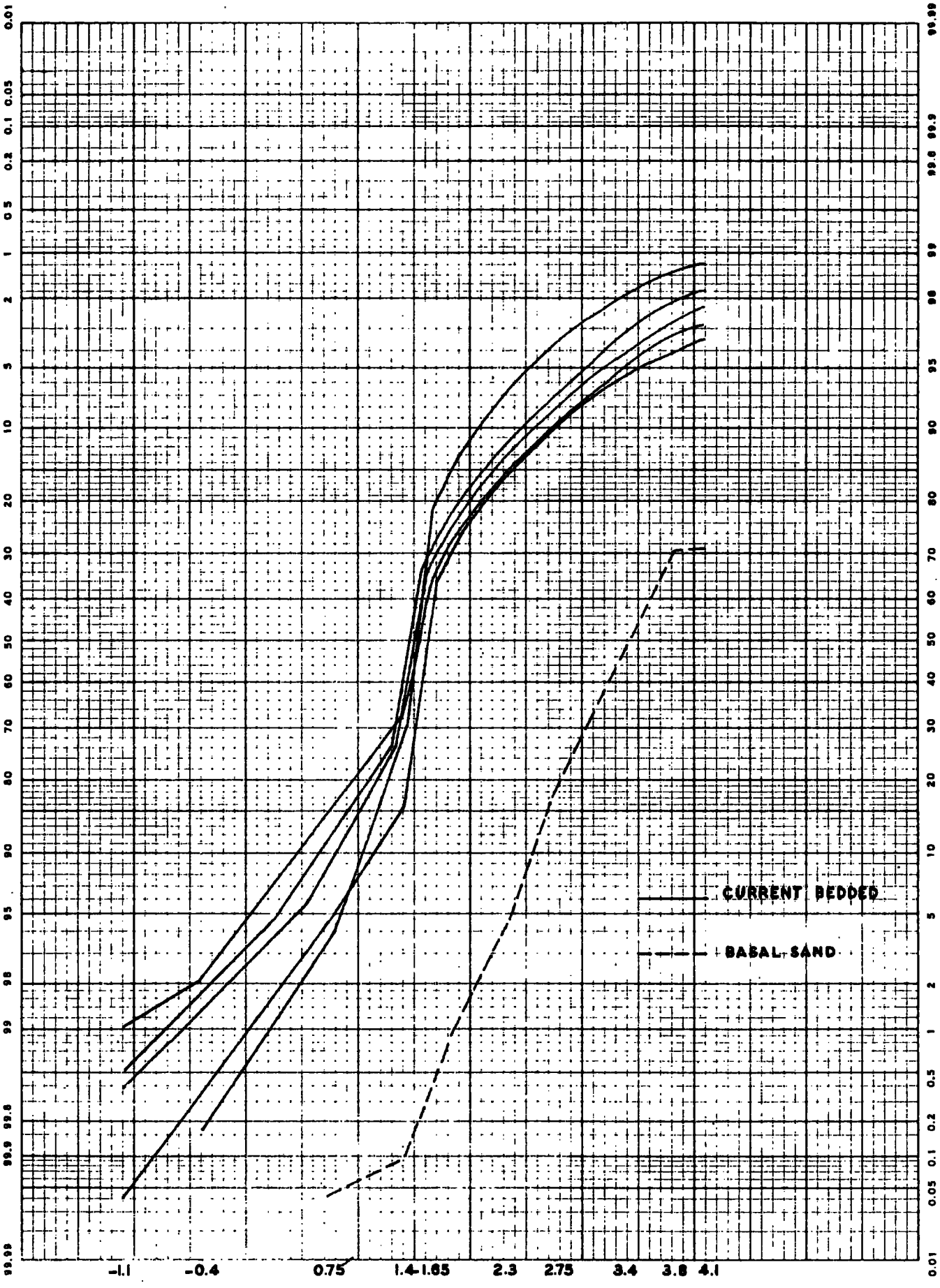


FIG. 107

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This bibliography does not attempt to include all works relevant to the subject under discussion but only those which, in the author's opinion, have led to a greater understanding of the relevant topics. Articles are listed under the relevant chapter with a sub-division between those works referenced in the text and other significant works.

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CHAPTER 3

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CHAPTER 8

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PHOTOGRAPHS.

PLATE I.

Supposed raised marine sand. Cat Nab, Saltburn.

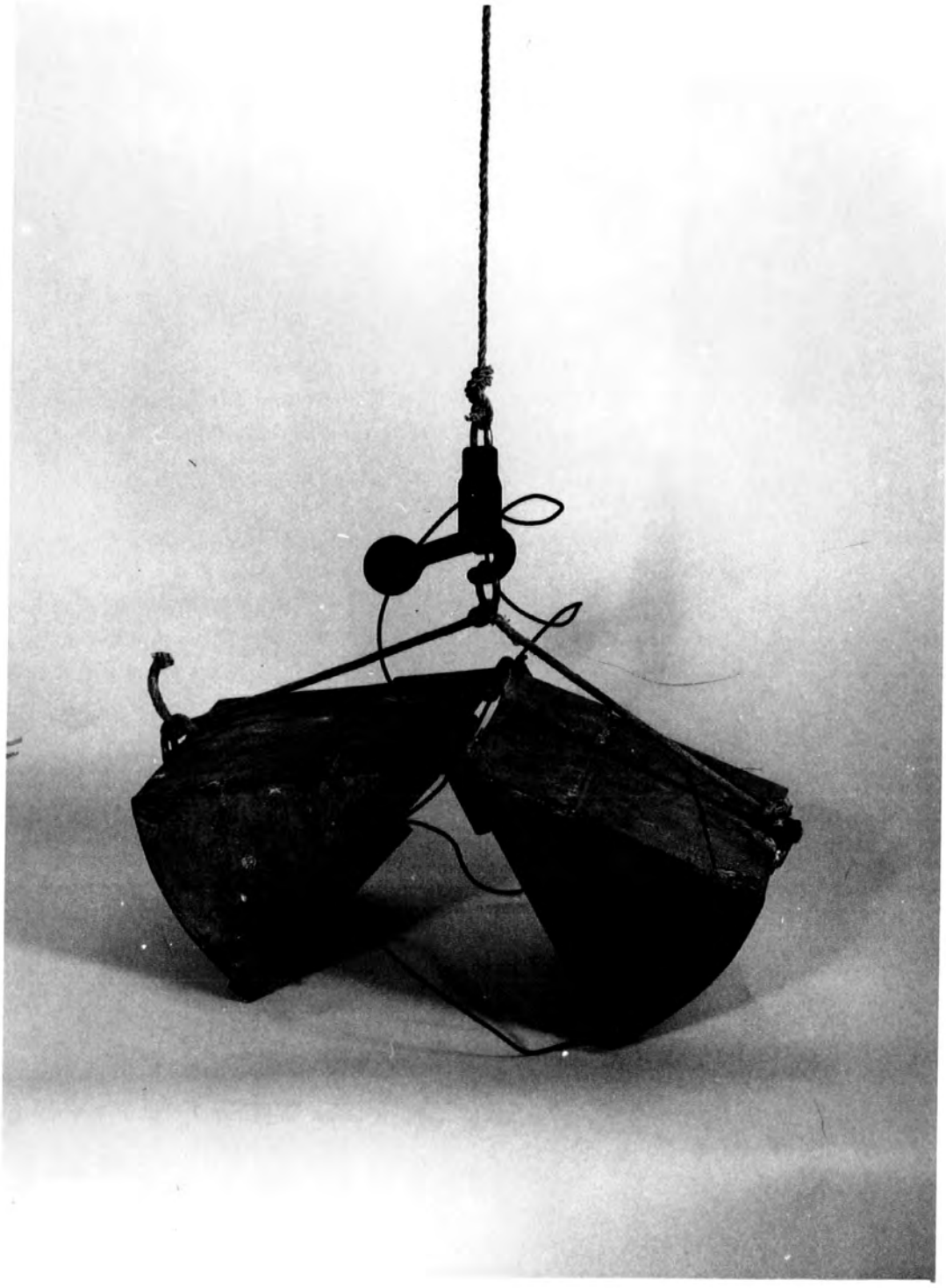
PLATE II.

BREAK OF SLOPE NEAR HOWDEN HALL FARM. LOWER TEES.

PLATE III.

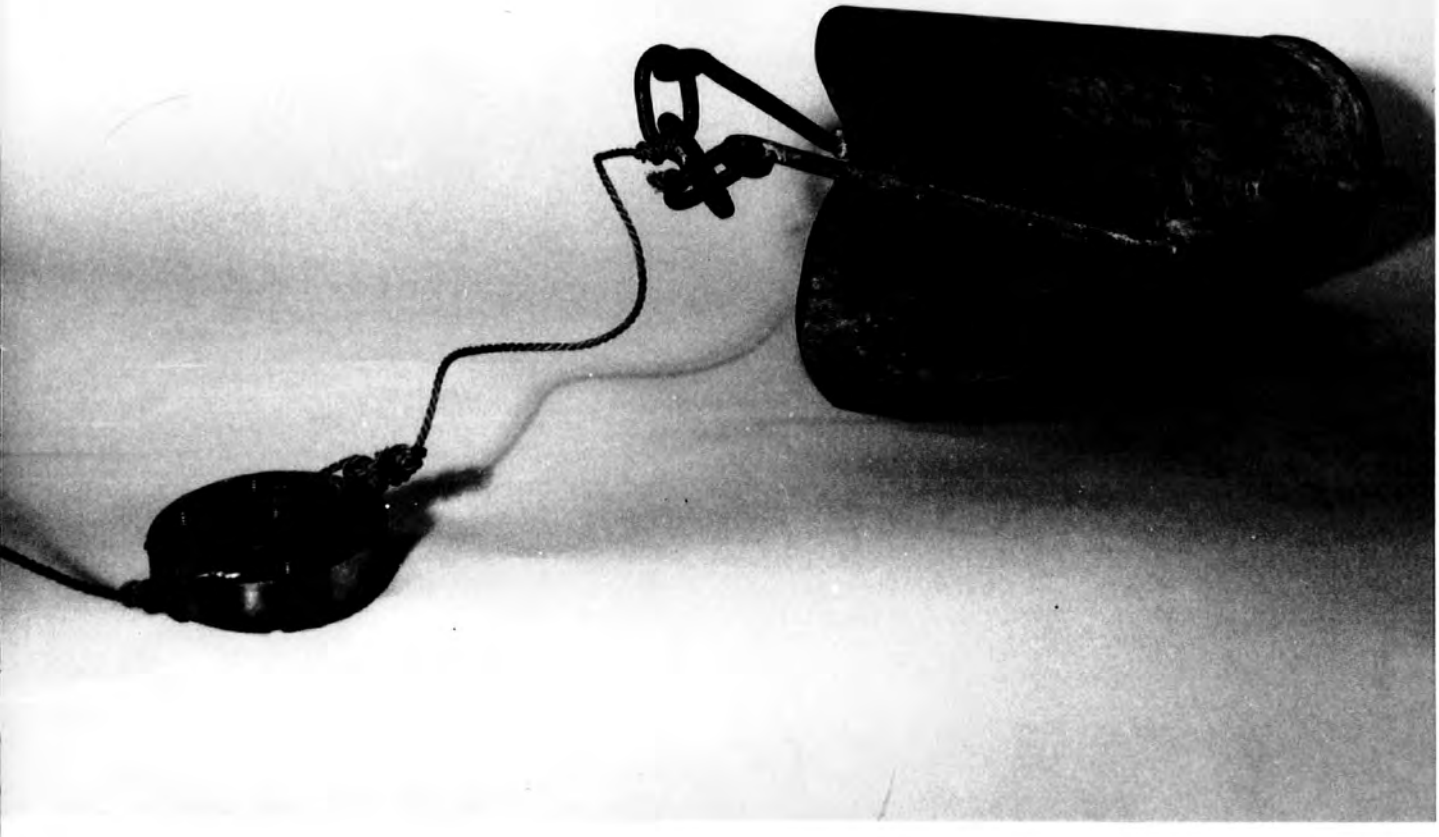
SUPPOSED RAISED STORM BEACH DEPOSITS NEAR HARTLEPOOL.

PLATE IV.



SEA BED GRAB SAMPLER AS USED IN THE TEES BAY.

PLATE V.



SEA BED BUCKET DREDGE AS USED IN THE TEES BAY.

MARINE SURVEY.

PLATE VI. VESSEL, EQUIPMENT, AND PERSONNEL USED DURING SAMPLING AND SOUNDING CRUISES.

PLATE VII. ECHO SOUNDER TRANSDUCER.

PLATE VIII. ECHO SOUNDING CHART RECORDER.

APPENDICES.

APPENDICES.

APPENDIX I

NATIONAL GRID REFERENCES OF PLACE NAMES REFERRED TO IN THE TEXT

Names are listed in the order they occur in the text.

O.S., Sheets 84, 85, 86.

THE LOWER TEES

Place Name	Location
Cleveland Hills	585017
Egglescliffe	421135
Billingham Beck	436233
River Leven	449114
Ormesby Beck	511181
Middle Beck	495175
Stainmore Pass	914109
Hutton Henry	425361
Stokesley	520084
Warrenby	581250
Coatham	591252
Redcar	615249
Saltburn	667215
Whitby	905109
Easington	417435
Hartlepool	522333
Throston	491338
Greatham	492277
Thorpe Thewles	400233

The Lower Tees - continued

Place Name	Location
Viewly Hill Farm	435237
Stockton	445225
Skelton Beck	667215
Windy Hill Farm	652218
Marske	645230
Ox Close Farm	651211
Pontac Farm	626211
Fell Briggs	613210
Sparrow Park Farm	621211
Turners House	601210
Long Beck House	625217
Cat Flats	623217
Black's Bridge	621215
Wheat Acres Farm	599218
Yearby	600210
Middlesbrough	495186
Kirkleatham Hall	595209
Fox Rush Farm	587221
Broadway Farm	560205
Town Farm	582207
Lackenby Hall	565195
Normanby High Farm	535195
Spencer Beck Farm	540180
Coulby Manor	496154
Sandy Flat Farm	493158
Stainsby Hall Farm	471152
High Leven	450123
Maltby	466137

The Lower Tees - continued

Place Name	Location
Barwick Farm	432146
Thornaby Vale	455145
Leven Month Farm	435122
Morley Carr	412110
Spittal Flat	428117
Howe Hill Cottages	355110
Hill House	354102
Over Dinsdale	362100
Girsby Grange Farm	385086
Old School (Girsby)	358094
Low Entercommon	335060
Eryholme	321088
Low Hail Farm	309097
Breakhouse Bank	332084
Garden House Farm	303106
Hurworth	305104
Hurworth Moor	315121
Middleton St. George	355140
Long Newton	380162
Tees Airport	375130
Elton	401174
Betty's Farm	405190
Coatham Stob	405162
Howden Hall	415225
Warren House Farm	437254
Woodside	436273
Wolviston	454258
Middle Burn Toft	457279

The Lower Tees - continued

Place Name	Location
Marsh House	461256
High Grange	457251
North Burn	462274
Claxton	476287
Cowpen Bewley	483247
Throston Grange	492341
Middle Warren	494346
Springwell House	488355
I.C.I. Wilton	585198
Girsby	355085
Seaham	437493
South Gare	557277
North Gare	542284
Seaton Carew	513301
Wynyard	418250
Stob House Farm	457272
Brierton	476300
Crimdon	487365
Cat Nab	668216
Huntcliff	691219
Newton Bewley	475266
Dalton Piercy	465312
Dinsdale	330115
Neasham	331102
The Slake	515328
Seal Sands	525252

APPENDIX II

LEVELLED HEIGHTS OF RAISED TERRACES

Terrace	Height (in feet)	Location
Skelton Beck, Saltburn	13.60	668217
" " "	13.35	
" " "	16.36	
" " "	17.26	
" " "	19.25	667213
Windy Hill	134.42	652218
" "	133.98	
" "	133.67	
" "	133.41	
" "	133.52	
" "	132.78	
" "	132.43	
" "	132.19	
" "	132.18	650219
Ox Close Farm	141.2	651211
" " "	143.16	
" " "	151.69	
" " "	152.11	
" " "	154.23	
" " "	155.07	
" " "	156.43	
" " "	154.12	
" " "	162.81	
" " "	164.45	
" " "	169.72	
" " "	170.08	
" " "	168.48	

Terrace	Height (in feet)	Location
Pontac Farm	168.01	626211
Fell Briggs	151.40	613210
" "	155.82	
" "	157.15	
" "	157.44	
Sparrow Park Farm	157.67	621211
Turners House	84.90	601210
" "	85.50	
" "	84.74	
" "	83.31	
" "	84.38	
" "	84.40	
" "	85.64	
" "	85.47	
" "	83.45	
" "	84.83	
" "	84.70	
" "	84.68	
Long Beck House	84.82	625217
Blacks Bridge	47.43	621215
" "	47.28	
" "	47.14	
" "	46.97	
" "	47.39	
" "	46.98	

Terrace	Height (in feet)	Location
Wheat Acres Farm	46.54	599218
Kirkleatham Hall	55.65	595207
" "	55.23	
" "	54.61	
" "	54.71	
" "	55.14	
" "	55.67	585215
ICI Wilton	52.56	580210
" "	52.91	
" "	51.91	
" "	52.50	
" "	52.47	
" "	52.42	
" "	52.37	575209
Broadway Farm	80.44	560205
" "	81.20	
" "	80.47	
" "	81.13	
" "	80.78	
" "	80.91	
" "	81.37	
" "	81.55	
Broadway Farm	78.92	560206
" "	78.76	
" "	78.48	

Terrace	Height (in feet)	Location
Broadway Farm	93.11	577203
" "	93.12	
" "	93.08	
" "	92.97	
" "	92.68	
" "	92.31	
" "	92.30	
Town Farm	92.17	582207
Lackenby Hall	75.68	565195
" "	75.79	
" "	76.31	
" "	77.09	
" "	77.18	
Spencer Beck Farm	100.07	540180
" " "	100.77	
" " "	98.59	
" " "	100.13	
" " "	100.38	536177
Normanby High Farm	50.69	535195
" " "	50.32	
" " "	49.91	
" " "	49.65	
" " "	49.42	
" " "	49.38	534195

Terrace	Height (in feet)		Location
Coulby Manor	High Terrace	Low Terrace	496154
" "	108.22	106.96	
" "	109.95	103.72	
" "	106.21	105.73	
" "	108.12	105.51	
" "	107.89	104.24	
" "		105.26	494154
Sandy Flats Farm	99.63	Low Terrace	493158
" " "	99.37	46.73	
" " "	99.14	46.43	
" " "	99.01		
" " "	98.94		
" " "	98.87		
" " "	98.93		497158
Stainsby Hall Farm	77.93		471152
" " "	77.40		
" " "	77.18		
" " "	77.29		
" " "	77.28		468152
High Leven	122.24	116.75	450123
" "	122.22	116.41	
" "	122.13	115.77	
Maltby	122.05	115.33	466137
"		115.30	

Terrace		Height (in feet)	Location
Barwick Farm		76.71	432146
Leven Mouth Farm		118.39	435122
" " "		118.40	
" " "		118.36	
" " "		118.21	
" " "		119.0	
" " "		118.61	
" " "		118.37	
" " "		118.35	
" " "		118.30	
" " "		118.31	
Morley Carr		118.31	412110
Howe Hill Cottages	1)	77.13	355110
" " "		77.77	
" " "		78.67	
" " "		79.04	
" " "		79.20	
" " "		79.50	
" " "		80.37	
" " "		80.45	
Howe Hill Cottages	2)	108.12	355110
" " "		106.78	
Howe Hill Cottages	3)	113.39	
" " "		113.95	
" " "		113.56	

Terrace		Height (in feet)	Location
East of Hill House		121.32	362100
"	"	122.49	
"	"	122.31	
"	"	122.84	
"	"	120.34	
"	"	118.49	
"	"	120.75	
"	"	121.97	
"	"	122.60	
"	"	122.78	
Rose Hill Farm		123.23	358104
Girsby Grange		144.76	385086
"	"	144.78	
"	"	144.89	
"	"	144.92	
"	"	144.95	
"	"	145.02	
"	"	145.02	
Old School Girsby	1)	132.4	358094
"	"	135.16	
"	"	132.26	
"	"	135.22	
"	"	135.37	
"			
"	"	2) 128.44	
"	"	129.42	
"	"	128.83	
"	"	129.08	
"	"	129.50	
"	"	129.59	

Terrace		Height (in feet)	Location
Low Entercommon	1)	174.24	335060
" "		174.55	
" "		174.61	
" "		174.72	
" "	2)	166.13	335060
" "		166.24	
" "		166.41	
Low Hail Farm		134.93	309097
" "		134.40	
" "		134.73	
" "		134.62	
" "		134.68	
" "		134.62	
" "		134.49	
" "		134.85	
Garden House Farm, Hurworth		118.20	303106
" "		120.22	
" "		119.60	
" "		120.22	
" "		118.05	
" "		118.05	
Hurworth Moor		131.67	315121
" "		130.94	
" "		130.82	
" "		131.30	
" "		131.60	
" "		130.75	

Terrace	Height (in feet)	Location
Middleton St. George	132.82	355140
" "	130.82	
" "	136.69	
" "	130.91	
" "	131.60	
" "	130.73	
" "	131.12	
" "	134.57	
" "	134.78	
" "	135.87	
" "	135.55	
" "	137.55	
" "	137.45	
Long Newton	137.84	380162
Long Newton	113.08	380162
" "	116.17	
" "	115.89	
" "	113.19	
" "	115.45	
" "	117.56	
" "	119.00	
" "	117.40	
" "	116.38	
" "	116.58	
Middleton St. George	119.47	355140

Terrace		Height (in feet)	Location
Elton		105.73	401174
"		105.77	
"		104.78	
"		104.67	
"		105.39	
"		105.13	
"		105.76	
Betty's Farm		106.42	405190
Coatham Stob	1)	94.81	
" "		94.82	
"			
" "	2)	79.75	
" "		79.82	
" "		79.94	
" "		80.21	
" "		80.29	
Coatham Stob (sand layer)	1)	94.86	405162
" "		94.86	
" "		94.87	
" "		94.88	
" "		94.89	
" "		94.89	
" "	2)	95.33	
" "		95.50	
" "		95.43	
" "		95.47	
" "		95.54	
" "		95.69	

Terrace	Height (in feet)	Location
North edge of Stockton	59.58	445225
	59.63	
Howden Hall	131.96	415225
" "	132.20	
" "	132.95	
" "	136.24	
Warren House Farm	111.36	437254
" " "	111.40	
" " "	112.06	
" " "	111.98	
" " "	112.01	
" " "	112.23	
" " "	112.49	
" " "	112.59	
Woodside	176.79	436273
"	175.94	
"	176.67	
"	178.80	
"	177.74	
Wolviston	109.91	454258
"	110.36	
"	110.73	
"	110.30	
"	109.63	
"	109.44	
"	107.42	

Terrace			Height (in feet)		Location
Wolvison (continued)			106.93		
"			108.56		
"			106.07		
"			108.51		
"			110.68		
Middle Burn Toft			109.94		457279
Marsh House		1)	59.81	2) 59.75	
"	"		59.78	59.51	
"	"		59.78	59.26	
"	"		59.66	59.25	
"	"		59.57		
"	"		59.51		
High Grange			59.23		457251
Middle Burn Toft		1) 53.55	2) 73.75	3) 68.45	457279
"	"	" 54.01	73.61	68.45	
"	"	" 53.14	73.54	68.41	
"	"	" 53.02	73.44	67.55	
"	"	" 52.44	73.32	67.45	
"	"	"		67.31	
"	"	"		66.48	
Claxton			61.24		476287
"			61.13		
"			61.30		
"			61.61		
"					

Terrace	Height (in feet)		Location
Claxton	1) 67.97	2) 45.19	476287
"	69.17		
"	67.38		
"	66.02		
Cowpen Bewley	19.05		483247
" "	17.51		
" "	15.82		
" "	14.80		
" "	14.64		
Throston Grange	60.19		492341
" "	60.23		
" "	58.33		
" "	59.32		
" "	60.34		
" "	60.41		
" "	60.52		
" "	60.60		
" "	60.22		
" "	60.99		
Middle Warren	60.66		494346

APPENDIX 3

METHODS OF SEDIMENTARY ANALYSES

1) Particle Size Analysis - Dry Sieving

1) Encompasses Size Range -2ϕ to $+4.2\phi$ (coarse sand to fine sand).

2) Apparatus

(a) British Standard Sieves plus shaker.

(b) Balance accurate to 0.01 grams.

(c) Sample Riffler.

(d) Drying Oven (constant temperature 105° to $110^{\circ}C$.

(e) Mortar and Pestle.

(f) Evaporating dishes.

(g) Spatulas.

3) Procedure

(a) Sample dried.

(b) Sample riffled to obtain 100 gram sample.

(c) Sample checked for grain conglomerates which result from inadequate washing before drying. (Only applicable to salt water samples).

(d) Sample sieved for up to 15 minutes.

(e) Residue on each sieve weighed and recorded as a percentage of the total sample weight

(f) Results recorded and presented graphically on arithmetic probability paper.

HEAVY MINERAL ANALYSIS -(See accompanying table)

Procedure

(a) Sample residues from the British Standard Sieves 72, 100, 150, 200, rewashed to remove dust.

(b) Sample redried.

(c) Sample subjected to hand magnet to remove magnetic and pyrhotite.

(d) Sample put through S.G. Franz Isodynamic separator (electro magnet.) (At least twice if not more times to obtain best separation.

(e) Weight of sample recorded before and after processing to determine weight loss.

(f) Weight loss recorded as a percentage of sample size fraction.

Other Mineralogical Studies

1) Mica Content

(a) Microscopic grain count per 1000 on each of the above four size fractions. (72, 100, 150, 200.)

Best results were obtained using X10 magnification under reflected light, with the grains on a black matt finished base.

2) Coal Content

(As above but with white background.)

3) Shell Content

(As above with black background.)

Other Mineralogical Studies - continued

4) Rock Fragments

(As above with black background and X20 magnification on smaller size fractions.)

APPENDIX 4*

PARTICLE SIZE ANALYSIS

Samples Used for Factor Analysis 1

Sieve Size British Standard	Percentage Sample Number								
	W1	W2	W3	W4	W5	W6	W7	W8	W9
8	0.04	0.04	-	-	0.08	0.08	2.92	0.08	0.2
14	0.02	0.06	0.14	0.12	0.08	0.48	2.41	0.42	0.82
25	0.36	0.8	0.34	0.38	1.21	1.29	4.08	1.29	3.02
36	0.64	1.04	0.56	0.58	0.4	0.58	1.91	0.78	5.61
52	1.5	2.02	0.66	0.76	0.78	1.01	2.91	2.1	24.16
72	2.4	3.0	1.2	1.2	2.8	4.92	9.31	7.19	46.23
100	5.5	6.26	3.6	3.8	23.42	37.77	31.54	10.75	16.51
150	37.9	37.90	67.2	66.4	53.57	47.8	28.88	33.0	2.2
200	26.8	28.22	20.6	21.06	8.95	3.89	4.31	17.2	0.14
240	12.56	11.06	2.86	3.08	2.26	0.51	3.4	9.2	0.07

Sieve Size	Percentage Sample Number								
	W10	W11	W12	W13	W14	W15	W16	W17	W18
8	0.02	-	0.06	0.2	0.08	0.1	0.05	0.1	0.1
14	0.26	0.2	0.39	0.45	0.3	0.4	0.29	0.2	0.18
25	2.26	1.68	1.95	2.6	1.1	1.2	1.28	0.85	0.92
36	4.89	0.7	1.12	2.89	1.22	1.15	1.59	0.3	0.8
52	10.29	1.48	2.48	13.49	5.35	5.21	5.9	0.53	0.8
72	41,85	4.18	6.2	46.15	17.68	18.1	18.93	0.62	1.08
100	27.23	7.2	8.0	23.91	19.78	19.07	19.2	6.1	6.4
150	4.33	30.7	31.07	4.09	34.28	35.98	34.64	38.42	40.9
200	0.11	21.0	18.5	0.1	12.91	12.1	11.26	33.5	28.1
240	0.01	11.12	10.39	0.01	3.62	3.47	3.08	12.28	12.9

* Appendices 4 and 5 have been restricted primarily to those samples which were used for factor analysis. This was done because many of the results were included in the text in graphical or summary table form and also because it was factor analysis which provided the key to the differentiation of depositional environments.

Sieve Size British Standard	Percentage								
	Sample Number								
	W19	W20	W21	W22	W23	W24	W25	W26	W27
8	1.1	0.27	0.4	0.08	0.51	0.27	0.38	0.09	0.09
14	1.82	0.41	0.71	0.2	0.5	0.52	0.35	0.3	0.21
25	3.16	1.75	2.11	1.08	0.92	1.3	1.01	0.95	0.95
36	1.28	0.99	0.91	0.81	0.32	0.48	0.48	0.42	0.44
52	2.22	1.09	1.02	0.92	0.6	0.7	0.78	0.71	0.69
72	8.0	2.0	2.5	1.7	2.95	2.8	3.59	3.59	4.03
100	29.7	12.48	16.17	10.92	19.58	18.61	23.67	24.03	25.38
150	46.5	36.09	36.8	34.1	54.09	55.79	53.33	56.25	55.37
200	4.8	15.89	14.0	17.1	16.21	15.3	12.98	11.2	10.5
240	0.44	8.09	6.51	8.03	2.76	2.09	1.68	1.3	1.13

Sieve Size	Percentage								
	Sample Number								
	W28	W29	W30	W31	W32	W33	W34	W35	W36
8	0.05	0.93	1.44	0.5	1.14	0.01	0.02	0.89	13.18
14	0.14	0.7	1.71	0.85	0.83	0.03	0.11	1.41	6.11
25	0.62	2.63	2.52	2.45	2.05	0.53	0.8	3.7	13.93
36	0.38	1.44	1.1	1.6	1.32	0.38	0.4	1.0	9.89
52	0.6	3.75	2.98	4.02	3.6	0.61	0.62	1.08	22.63
72	3.98	25.33	21.1	24.92	24.52	1.8	2.25	2.4	26.25
100	27.38	53.92	54.9	52.55	52.6	14.53	16.13	15.3	6.52
150	53.5	9.95	12.58	11.6	12.22	48.63	48.79	42.99	0.74
200	11.02	0.6	0.92	0.7	0.8	19.05	16.31	13.89	0.05
240	1.1	0.1	0.15	0.08	0.12	6.54	5.91	5.75	-

Sieve Size British Standard	Percentage								
	Sample Number								
	W37	W38	W39	W40	W41	W42	W43	W44	W45
8	0.4	0.6	3.6	1.1	2.0	1.81	2.3	60.9	57.6
14	1.12	18.6	3.02	1.1	1.51	1.23	1.3	10.7	9.7
25	2.6	24.42	7.6	1.9	1.89	2.08	1.13	11.92	12.89
36	2.6	10.41	5.9	0.98	0.81	0.98	0.8	3.32	4.29
52	14.41	10.52	15.28	1.7	1.61	2.01	1.86	2.6	3.5
72	48.23	9.0	36.46	13.6	13.9	13.47	15.32	2.0	3.0
100	23.2	6.51	18.5	58.4	59.55	57.89	59.59	5.7	5.78
150	4.18	5.97	5.91	19.82	17.37	19.73	15.9	2.21	2.21
200	0.72	3.21	1.18	0.8	1.1	0.7	0.58	0.14	0.27
240	0.38	1.52	0.42	0.1	0.11	0.1	0.09	0.08	0.11

Sieve Size	Percentage								
	Sample Number								
	W46	W47	W48	W49	W50	W51	W52	W53	W54
8	70.2	0.18	0.09	0.15	0.19	0.13	0.08	0.41	0.21
14	11.47	0.25	0.58	0.6	0.47	0.49	0.1	0.8	0.64
25	11.16	0.8	3.03	3.48	1.95	1.59	1.38	2.21	1.31
36	2.8	0.62	4.42	3.56	2.25	1.5	0.68	1.2	0.61
52	1.71	1.95	12.0	9.23	7.45	4.82	1.47	1.81	1.17
72	0.75	17.37	23.5	22.78	23.9	19.0	6.85	12.1	6.42
100	1.13	69.1	32.03	33.1	37.13	40.5	65.47	60.02	62.87
150	0.47	9.38	20.85	23.81	23.61	28.9	22.6	19.64	25.03
200	0.09	0.12	1.69	1.75	1.58	1.7	0.7	0.76	0.97
240	0.03	0.05	0.2	0.18	0.11	0.2	0.11	0.11	0.19

Sieve Size	Percentage								
British Standard	Sample Number								
	W55	W56	W57	W58	W59	W60	W61	W62	W63
8	0.03	3.0	3.3	0.15	0.1	0.1	0.1	0.1	0.15
14	0.39	1.88	2.31	0.79	1.0	0.45	0.26	0.32	0.48
25	0.88	2.6	3.51	1.87	1.8	2.5	0.7	0.82	1.07
36	0.48	1.06	1.52	0.77	0.66	0.89	0.28	0.3	0.48
52	1.0	1.95	2.9	1.11	1.1	1.02	0.36	0.48	0.54
72	5.56	7.32	9.4	2.16	1.88	1.9	0.9	1.1	1.26
100	62.15	30.05	29.32	14.4	12.04	13.06	9.6	9.62	10.11
150	27.71	45.6	41.62	55.26	56.12	56.0	62.02	63.0	59.3
200	1.09	5.1	4.69	13.35	16.5	12.41	20.0	18.02	20.65
240	0.2	0.41	0.4	2.89	2.89	3.0	3.33	3.2	3.41

Sieve Size	Percentage								
	Sample Number								
	W64	W65	W66	W67	W68	W69	W70	W71	W72
8	0.03	0.06	0.02	0.37	0.15	0.08	0.09	0.1	0.5
14	0.45	0.6	0.28	0.6	0.41	0.42	0.69	0.68	0.22
25	1.39	2.31	1.63	1.6	1.37	1.25	2.38	1.29	2.12
36	0.9	1.3	1.2	1.0	0.89	0.99	0.9	0.55	0.72
52	3.63	4.43	3.34	2.9	2.4	2.72	1.78	1.67	1.71
72	16.52	15.21	15.01	11.0	9.4	10.3	9.02	10.99	9.48
100	22.81	20.2	21.77	18.58	17.15	18.3	23.75	26.29	24.6
150	27.43	27.6	27.93	48.7	50.45	49.98	32.5	31.7	31.91
200	11.02	9.67	9.7	9.89	11.43	10.78	10.22	10.81	12.0
240	4.05	4.91	4.5	2.41	2.86	2.46	4.63	4.63	5.05

Sieve Size British Standard	Percentage								
	Sample Number								
	W73	W74	W75	W76	W77	W78	W79	W80	W81
8	0.15	0.02	0.1	0.01	0.11	-	-	0.15	0.2
14	0.23	0.2	0.75	1.1	0.37	0.28	0.5	0.6	0.5
25	1.92	1.88	2.0	4.22	2.2	2.91	2.02	1.65	1.85
36	0.7	0.78	0.75	1.2	0.75	1.1	0.72	0.61	1.98
52	1.6	1.7	1.91	2.09	1.55	2.11	1.7	1.6	5.95
72	8.85	9.35	10.74	8.97	8.41	10.19	10.4	9.18	18.91
100	23.35	23.52	25.05	22.44	22.25	24.15	25.86	24.5	3.04
150	33.3	30.9	32.08	28.32	33.25	30.2	31.1	33.8	34.7
200	11.25	11.48	11.21	10.84	11.15	8.02	9.9	10.81	2.6
240	5.5	5.32	4.22	4.95	5.19	5.78	4.5	5.1	0.58

Sieve Size	Percentage								
	Sample Number								
	W82	W83	W84	W85	W86	W87	W88	W89	W90
8	0.07	0.08	0.1	0.1	0.09	0.04	0.02	0.17	0.4
14	0.3	0.3	0.42	0.39	0.3	0.51	0.12	0.52	0.88
25	1.22	1.73	1.89	1.82	1.7	1.92	1.0	3.1	4.47
36	1.84	2.88	1.92	4.38	4.45	4.09	3.55	2.1	3.28
52	6.35	8.21	6.34	19.0	18.9	18.89	17.81	3.55	5.4
72	21.03	24.26	19.48	44.32	45.3	45.81	43.62	5.12	6.68
100	32.34	30.0	31.79	23.51	23.48	22.82	26.89	9.9	10.42
150	32.13	28.07	33.78	5.01	4.93	4.8	5.95	37.0	27.78
200	2.1	2.08	2.51	0.03	0.1	0.09	0.1	19.2	16.18
240	0.62	0.41	0.3	0.2	0.12	0.2	0.27	4.66	4.1

Sieve Size British Standard	Percentage								
	Sample Number								
	W91	W92	W93	W94	W95	W96	W97	W98	W99
8	0.39	0.52	0.18	0.11	0.01	0.01	0.21	0.1	0.17
14	0.58	1.15	0.9	0.89	0.6	0.48	2.6	0.87	0.71
25	2.9	2.81	2.3	2.51	2.64	2.4	4.65	2.31	1.49
36	1.98	1.29	1.0	0.9	1.21	0.95	1.32	0.89	0.7
52	2.6	1.95	1.38	1.26	1.53	1.35	1.6	1.1	1.04
72	3.36	3.2	2.65	2.39	2.71	2.72	3.55	2.78	2.5
100	12.0	13.95	12.88	14.01	13.5	13.32	26.92	13.75	14.7
150	39.75	41.09	42.41	41.49	41.53	41.83	40.62	44.6	44.32
200	17.48	16.51	16.78	16.39	19.1	17.52	9.55	15.15	16.87
240	3.61	2.71	3.63	3.7	2.83	2.78	0.6	2.8	2.98

Sieve Size	Percentage								
	Sample Number								
	W100	W101	W102	W103	W104	W105	W106	W107	W108
8	-	-	0.02	-	0.09	0.08	0.02	0.13	0.21
14	0.55	0.22	0.38	0.32	0.11	0.37	0.27	0.3	0.49
25	2.41	1.39	1.49	0.92	1.92	1.25	0.9	0.81	0.9
36	1.35	0.87	0.77	1.2	2.3	2.2	2.01	0.52	0.52
52	1.25	0.88	0.7	1.41	15.89	16.12	14.41	1.33	1.32
72	3.13	2.92	2.42	3.45	50.6	49.92	47.78	16.14	15.49
100	15.26	15.96	16.6	16.32	23.7	24.4	27.33	32.12	31.29
150	44.55	44.48	45.61	41.7	3.3	4.6	6.28	42.27	43.1
200	13.82	16.6	14.59	15.52	0.15	0.23	0.32	4.2	4.32
240	3.37	3.0	3.49	2.38	0.2	0.02	0.2	0.46	0.47

Sieve Size British Standard	Percentage								
	Sample Number								
	W109	W110	W111	W112	W113	W114	W115	W116	W117
8	0.07	0.26	0.16	0.22	1.01	0.1	0.21	0.24	-
14	0.29	0.49	0.29	0.5	0.61	0.13	0.69	0.41	0.3
25	0.77	1.0	0.7	1.1	1.29	0.46	1.8	1.11	1.66
36	0.43	0.52	0.39	0.59	0.5	0.32	1.0	1.0	1.0
52	1.3	1.4	0.63	0.89	0.59	0.47	1.2	1.42	1.3
72	17.53	17.48	9.41	11.58	8.23	7.75	13.42	10.59	12.1
100	32.88	33.13	67.56	63.93	61.91	66.5	58.86	62.9	58.8
150	40.61	39.67	19.71	19.8	24.11	22.89	20.9	20.66	22.3
200	3.7	3.7	0.5	0.55	0.62	0.62	1.0	0.91	1.31
240	0.46	0.31	0.05	0.1	0.1	0.1	0.13	0.15	0.2

Sieve Size									
	Sample Number								
	W118	W119	W120	W121	W122	W123	W124	W125	W126
8	0.25	0.13	0.41	0.4	0.55	9.67	32.72	6.7	4.4
14	0.4	0.9	1.4	0.8	1.92	14.2	13.28	12.82	7.12
25	1.35	5.67	9.46	6.83	10.88	18.26	15.85	29.19	22.12
36	0.87	10.1	14.39	12.32	15.02	10.95	5.91	16.6	17.11
52	1.03	21.89	23.0	25.23	23.89	12.25	5.27	13.71	16.05
72	11.97	38.91	33.75	38.59	34.32	16.68	6.5	12.5	18.6
100	59.1	17.23	13.5	12.83	10.8	8.04	6.28	5.37	9.7
150	22.41	3.63	2.77	2.06	1.65	4.42	5.1	1.92	3.36
200	1.26	0.2	0.12	0.1	0.08	3.11	2.9	0.18	0.27
240	0.18	0.01	0.01	0.01	0.01	0.6	0.5	0.02	0.05

Sieve Size	Percentage								
British Standard	Sample Number								
	W127	W128	W129	W130	W131	W132	W133	W134	W135
8	0.2	0.17	0.02	-	-	-	0.59	0.01	0.5
14	0.67	0.49	0.2	0.26	0.13	0.16	0.32	0.32	0.51
25	1.21	2.71	0.6	0.97	0.7	1.1	1.83	1.5	1.28
36	2.4	7.8	0.4	0.58	0.33	0.65	1.1	0.97	0.81
52	17.57	22.5	0.69	0.88	0.53	1.01	1.9	1.6	1.4
72	52.2	47.2	16.6	17.3	15.4	17.8	14.3	12.32	12.3
100	22.55	15.11	64.99	63.09	64.76	63.95	53.58	54.6	54.9
150	2.62	2.1	15.58	15.75	16.7	14.02	22.9	25.11	24.5
200	0.11	0.17	0.47	0.48	0.6	0.42	1.96	2.17	2.4
240	0.01	0.08	0.03	0.03	0.06	0.03	0.22	0.25	0.3

Sieve Size	Percentage				
	Sample Number				
	W136	W137	W138	W139	W140
8	0.01	0.12	-	-	-
14	0.27	0.12	0.2	0.1	0.09
25	1.08	0.65	0.9	0.5	0.5
36	0.7	0.38	0.4	0.31	0.31
52	1.25	0.4	0.4	0.32	0.39
72	11.45	1.8	2.1	1.76	2.13
100	53.4	30.47	32.98	32.53	33.42
150	28.0	54.4	53.17	54.56	53.62
200	2.53	9.49	8.1	8.1	7.71
240	0.31	0.72	0.59	0.55	0.59

Sieve Size British Standard	Percentage								
	Sample Number								
	D1	D2	D3	D4	D5	D6	D7	D8	D9
8	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	0.02	-
25	0.2	-	0.1	0.1	0.04	0.1	0.1	0.12	0.1
36	0.2	0.1	0.15	0.2	0.2	0.8	1.04	1.0	1.0
52	7.0	4.24	5.62	10.8	8.24	36.24	37.0	26.4	25.8
72	61.56	54.8	58.18	62.44	61.1	57.2	56.8	61.96	62.0
100	27.54	36.6	32.07	24.4	27.66	4.58	4.4	9.6	10.2
150	1.76	3.0	2.38	1.4	1.8	0.2	0.2	0.20	0.3
200	0.02	0.2	0.11	-	-	-	-	-	-
240	-	-	-	-	-	-	-	-	-

Sieve Size	Percentage			
	Sample Number			
	D10	D11	D12	D13
8	-	-	-	-
14	-	-	-	-
25	-	-	0.02	0.04
36	0.1	0.1	0.42	0.5
52	9.24	8.52	10.64	10.4
72	58.44	59.7	59.76	60.9
100	29.04	29.3	26.38	25.5
150	1.84	1.84	1.90	2.2
200	0.1	0.08	0.12	0.18
240	0.06	0.06	0.04	0.06

Sieve Size British Standard	Percentage								
	Sample Number								
	B1	B2	B3	B4	B5	B6	B7	B8	B9
8	0.36	0.19	0.32	0.54	0.44	0.8	0.2	0.8	0.36
14	0.36	0.28	0.62	0.4	0.84	0.96	0.8	0.64	0.76
25	2.64	2.62	4.54	4.0	4.4	4.4	4.38	3.30	3.98
36	17.66	18.43	18.2	18.0	12.64	11.62	11.84	10.1	12.44
52	52.66	50.47	43.22	43.24	40.66	40.64	39.24	37.50	40.54
72	23.0	24.3	27.44	27.94	34.76	35.82	37.72	40.26	35.8
100	2.4	2.66	4.4	4.84	4.56	4.6	5.2	6.6	5.4
150	0.04	0.04	0.18	0.2	0.30	0.32	0.32	0.4	0.34
200	-	-	-	-	0.02	-	0.04	-	0.04
240	-	-	-	-	-	-	-	-	-

Sieve Size	Percentage								
	Sample Number								
	B10	B11	B12	B13	B14	B15	B16	B17	B18
8	0.4	0.18	0.16	1.36	1.50	1.2	1.32	0.4	0.92
14	0.5	0.6	0.5	1.56	1.2	1.32	1.64	0.9	1.10
25	3.9	5.58	5.0	6.14	4.62	3.84	6.36	6.54	4.2
36	13.18	14.72	13.0	7.62	6.46	6.2	9.46	7.97	5.64
52	42.3	39.24	38.5	16.5	14.8	15.8	19.86	18.76	14.76
72	34.24	33.4	35.98	30.44	31.64	32.86	30.92	34.0	33.32
100	4.54	5.22	5.74	32.42	35.32	35.22	27.8	28.66	36.74
150	0.2	0.3	0.24	3.2	3.64	3.02	2.24	2.04	2.94
200	-	-	-	-	-	-	-	-	-
240	-	-	-	-	-	-	-	-	-

Sieve Size	Percentage								
British Standard	Sample Number								
	B19	B20	B21	B22	B23	B24	B25	B26	B27
8	-	0.26	-	0.2	0.16	-	1.2	1.10	0.6
14	0.16	0.34	0.02	0.12	0.02	0.02	0.96	1.02	1.4
25	2.2	1.94	1.0	1.54	0.76	0.6	1.8	2.04	3.42
36	5.8	3.18	3.96	5.38	0.98	1.0	1.42	1.78	1.58
52	17.04	10.92	22.6	25.84	4.78	4.8	8.02	3.24	2.8
72	37.34	32.38	44.44	43.12	34.36	38.84	19.50	17.14	17.36
100	34.0	45.66	26.16	22.4	54.36	50.12	59.94	61.96	60.42
150	3.04	4.98	1.56	1.4	4.36	4.24	11.6	11.32	11.64
200	-	0.04	-	-	0.04	0.04	0.14	0.16	0.14
240	-	-	-	-	-	-	-	-	-

Sieve Size	Percentage								
	Sample Number								
	B28	B29	B30	B31	B32	B33	B34	B35	B36
8	0.76	0.46	0.64	0.3	0.4	0.96	1.44	0.76	0.66
14	1.34	0.6	0.8	0.98	0.7	0.84	1.78	1.36	1.06
25	3.02	0.8	1.4	1.6	1.58	0.9	3.94	2.74	2.12
36	1.5	1.06	0.8	0.64	1.04	1.26	1.6	2.16	1.5
52	2.78	2.06	1.70	1.46	1.92	2.46	2.92	4.18	3.34
72	19.02	16.2	13.82	11.2	11.44	15.44	14.88	18.02	15.98
100	60.0	64.02	65.78	66.26	65.94	63.4	59.08	58.32	61.94
150	11.22	13.58	14.78	17.32	16.78	14.64	14.14	12.2	13.16
200	0.14	0.2	0.2	0.24	0.2	0.24	0.2	0.2	0.18
240	-	-	-	-	-	-	-	-	-

Sieve Size British Standard	Percentage					
	Sample Number					
	B37	B38	B39	B40	B41	B42
8	0.08	0.18	0.36	0.18	0.2	0.1
14	0.18	0.18	0.36	0.2	0.1	0.16
25	0.66	0.62	1.36	1.14	0.64	1.0
36	1.26	1.22	1.64	1.58	0.9	1.22
52	10.34	10.44	9.14	8.62	6.4	7.44
72	37.22	36.8	46.28	43.4	34.8	38.96
100	38.1	39.02	33.44	36.58	43.72	40.56
150	11.52	11.30	7.18	7.86	12.84	10.2
200	0.14	0.14	0.18	0.12	0.16	0.1
240	0.04	0.10	0.06	0.04	0.02	0.02

Sieve Size	Percentage								
British Standard	Sample Number								
	R1	R2	R3	R4	R5	R6	R7	R8	R9
8	0.86	1.0	0.1	0.04	3.76	1.41	2.7	1.63	0.8
14	1.82	2.98	0.3	0.2	6.1	3.01	3.8	2.96	3.16
25	27.54	33.1	5.9	6.04	27.0	24.78	21.3	19.92	31.18
36	29.6	28.96	10.38	11.62	17.6	21.8	17.98	19.32	25.68
52	23.4	20.9	22.36	24.6	13.96	20.78	15.68	20.93	18.14
72	9.2	7.2	23.62	23.56	7.6	11.27	9.04	12.84	6.6
100	3.24	3.22	16.24	15.4	4.56	6.11	5.84	6.74	3.06
150	1.76	1.41	10.78	10.12	4.0	4.62	4.84	6.06	2.72
200	0.46	0.36	3.70	3.0	1.56	1.77	1.94	2.39	1.16
240	0.22	0.2	1.62	1.3	0.82	0.92	1.04	1.21	0.68

Sieve Size	Percentage		
	Sample Number		
	R10	R11	R12
8	2.21	0.34	0.56
14	5.23	0.76	1.39
25	39.11	14.4	19.37
36	24.58	23.04	26.13
52	14.89	27.86	27.28
72	4.89	14.62	12.2
100	2.23	6.81	5.04
150	3.9	4.97	3.24
200	0.8	1.92	1.11
240	0.42	1.0	0.58

Sieve Size British Standard	Percentage								
	Sample Number								
	U1	U2	U3	U4	U5	U6	U7	U8	U9
8	0.4	0.6	0.4	1.86	0.4	0.12	-	-	-
14	0.84	1.0	0.84	0.84	0.24	0.18	-	-	0.02
25	10.0	9,3	13.6	12.84	4.26	4.0	0.04	0.04	0.1
36	24.2	21.8	16.5	16.9	10.9	10.4	0.06	0.06	0.1
52	37.4	36.3	37.7	38.42	48.2	48.74	0.22	0.22	0.38
72	17.30	18.84	21.26	21.06	24.4	25.16	2.7	2.8	4.2
100	5.04	6.26	4.4	4.0	5.52	5.56	16.2	17.5	40.2
150	1.7	2.4	1.74	1.4	2.44	2.4	35.02	34.0	44.64
200	0.2	0.4	0.4	0.2	0.6	0.6	16.16	16.0	6.84
240	-	-	0.12	-	0.1	0.1	0.2	3.22	1.4

Sieve Size	Percentage								
	Sample Number								
	U10	U11	U12	U13	U14	U15	U16	U17	U18
8	-	-	0.18	0.2	-	3.4	2.8	0.92	0.76
14	0.04	0.12	0.16	0.24	0.1	5.64	4.82	1.34	1.44
25	0.04	0.22	0.4	0.3	0.36	7.0	6.94	19.84	22.72
36	0.1	0.22	0.38	0.32	0.4	4.22	4.1	34.54	35.9
52	0.32	1.8	2.22	3.0	3.44	10.0	9.76	28.0	26.44
72	2.8	13.12	15.0	20.0	21.0	19.04	19.14	8.36	7.56
100	31.78	31.8	31.34	33.8	32.72	20.16	20.44	2.28	2.4
150	51.62	35.96	35.34	24.8	25.4	17.8	18.56	1.36	1.16
200	8.2	9.4	9.0	7.32	6.78	5.62	6.0	0.42	0.4
240	2.42	3.16	2.8	3.2	3.0	2.24	2.24	0.28	0.16

Sieve Size British Standard	Percentage								
	Sample Number								
	U19	U20	U21	U22	U23	U24	U25	U26	U27
8	0.6	0.64	0.2	0.24	-	-	2.54	2.6	1.58
14	0.9	1.0	0.38	0.4	0.12	0.18	2.2	1.6	2.2
25	8.9	10.22	5.56	6.9	3.92	4.42	10.44	8.62	6.4
36	20.64	22.38	21.5	24.2	23.6	25.78	15.02	13.76	10.98
52	39.76	40.1	42.0	43.34	48.24	48.68	26.8	26.16	26.76
72	17.5	16.18	18.24	15.84	15.84	14.6	21.32	22.0	23.46
100	5.6	4.82	6.42	4.8	3.84	3.42	11.24	12.5	13.6
150	2.46	1.94	2.8	1.72	1.6	1.2	5.48	6.6	8.04
200	0.72	0.54	0.78	0.4	0.5	0.42	1.42	1.84	2.3
240	0.28	0.26	0.22	0.24	0.34	0.14	0.6	0.76	0.96

Sieve Size	Percentage								
	Sample Number								
	U28	U29	U30	U31	U32	U33	U34	U35	U36
8	1.4	2.0	1.3	0.08	0.1	0.18	0.06	-	-
14	1.5	1.96	2.26	0.14	0.06	0.2	0.08	-	-
25	5.48	9.76	10.16	0.26	0.33	0.42	0.36	0.24	0.1
36	11.22	13.62	13.64	0.32	1.16	0.36	1.0	0.32	0.2
52	26.28	25.2	24.4	3.1	8.44	3.5	7.86	2.0	2.02
72	23.16	21.0	21.18	19.4	24.6	20.58	24.36	14.0	15.5
100	14.02	12.76	13.30	33.14	30.44	34.64	30.56	25.56	28.2
150	8.46	7.5	7.6	27.46	22.64	27.78	23.46	28.36	31.38
200	2.64	2.18	2.34	7.36	6.64	7.6	7.2	10.9	12.62
240	1.18	1.0	0.96	2.78	2.8	3.08	2.98	5.16	5.54

Sieve Size British Standard	Percentage								
	Sample Number								
	U37	U38	U39	U40	U41	U42	U43	U44	U45
8	0.2	0.06	0.6	0.2	0.2	0.02	0.4	0.26	0.04
14	0.2	0.2	0.46	0.6	0.24	0.06	0.2	0.44	0.16
25	0.48	0.68	2.24	0.6	0.78	0.84	1.22	1.64	0.66
36	1.84	1.52	6.0	6.22	3.06	3.44	4.42	5.0	3.02
52	9.62	11.26	21.8	22.24	18.18	19.97	23.5	25.0	19.8
72	35.74	35.1	40.36	39.9	43.24	44.2	41.3	40.56	44.88
100	28.96	28.6	19.04	19.36	23.24	20.6	18.56	18.2	20.84
150	13.78	13.3	5.6	5.56	7.36	6.64	6.0	5.42	6.56
200	3.8	3.6	1.14	1.04	1.5	1.4	1.4	1.14	1.36
240	1.4	1.2	0.44	0.4	0.2	0.2	0.6	0.38	0.42

Sieve Size	Percentage								
	Sample Number								
	U46	U47	U48	U49	U50	U51	U52	U53	U54
8	0.24	0.14	0.6	-	-	-	0.12	-	-
14	0.16	0.2	0.24	0.1	0.06	-	0.06	-	-
25	0.82	0.8	0.98	0.12	0.12	0.02	0.1	0.02	0.1
36	3.4	2.94	3.4	0.36	0.42	0.3	0.4	0.2	0.2
52	21.16	18.92	19.44	14.36	14.36	12.18	14.26	8.6	10.4
72	44.02	44.16	44.48	53.02	51.4	51.82	54.06	51.5	54.02
100	19.4	23.0	22.0	25.7	26.42	27.78	25.7	31.5	29.3
150	6.44	6.5	6.16	4.8	5.6	6.02	4.56	6.7	5.18
200	1.54	1.12	1.78	0.4	0.68	0.76	0.4	0.8	0.42
240	0.6	0.4	0.2	0.2	0.28	0.28	0.2	0.34	0.16

Sieve Size British Standard	Percentage								
	Sample Number								
	U55	U56	U57	U58	U59	U60	U61	U62	U63
8	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	0.04	-	-	-
25	-	-	0.02	-	0.04	0.04	-	0.04	0.16
36	0.1	0.06	0.16	0.16	0.38	0.32	0.02	0.1	0.24
52	5.2	5.58	7.16	9.0	13.4	11.96	0.14	0.26	0.4
72	47.4	48.22	50.6	53.4	52.84	53.58	0.4	0.36	0.42
100	35.5	35.2	32.44	29.48	25.78	26.8	12.62	12.56	18.1
150	9.04	8.58	7.4	5.98	5.44	5.42	45.4	46.04	47.74
200	1.5	1.2	1.0	0.64	0.7	0.6	22.26	21.72	18.7
240	0.6	0.4	0.4	0.26	0.26	0.22	13.16	12.8	10.2

Sieve Size									
	Sample Number								
	U64	U65	U66	U67	U68	U69	U70	U71	U72
8	-	-	-	-	-	-	-	-	-
14	0.14	-	-	-	-	-	-	-	-
25	0.34	0.1	0.06	0.02	0.04	0.04	0.01	0.04	0.04
36	0.36	0.1	0.1	0.06	0.06	0.06	0.02	0.04	0.04
52	0.36	0.2	0.2	0.1	0.14	0.1	0.02	0.04	0.04
72	0.6	0.42	0.36	0.36	0.42	0.2	0.2	0.3	0.2
100	14.6	12.2	10.44	13.58	12.24	8.2	9.1	9.8	10.7
150	45.42	47.2	43.8	47.42	48.6	42.8	41.9	42.06	41.2
200	21.24	21.6	22.16	23.24	23.16	23.0	22.6	21.36	20.42
240	11.9	13.38	13.84	12.78	12.78	13.84	13.78	12.38	12.04

Sieve Size British Standard	Percentage								
	Sample Number								
	U73	U74	U75	U76	U77	U78	U79	U80	U81
8	0.3	0.22	0.4	0.06	0.42	0.28	0.3	0.3	1.08
14	9.72	7.04	8.8	4.16	11.6	5.6	1.42	0.66	1.62
25	28.06	23.1	24.82	16.54	30.0	21.44	19.7	14.52	14.9
36	22.64	22.38	19.4	17.56	20.16	19.1	13.7	15.9	14.3
52	24.56	26.72	18.72	20.56	17.38	20.6	13.49	17.01	16.6
72	9.9	12.44	12.58	16.62	9.8	15.0	11.1	12.63	13.1
100	2.58	4.04	7.6	11.64	5.24	9.32	9.45	9.52	10.5
150	0.86	2.0	4.5	7.4	1.82	5.98	12.48	11.77	13.4
200	0.2	0.52	0.24	2.4	1.04	1.4	5.2	7.49	5.39
240	0.12	0.24	1.70	1.2	0.14	0.8	4.9	1.52	1.62

Sieve Size	Percentage							
	Sample Number							
	U82	U83	U84	U85	U86	U87	U88	U89
8	8.08	0.4	0.5	1.1	-	-	11.41	10.1
14	5.12	1.4	1.0	1.51	-	-	2.2	3.4
25	14.28	18.6	14.38	15.1	0.23	0.1	6.4	7.1
36	7.8	14.2	15.4	13.9	0.20	0.31	13.1	12.8
52	16.2	14.0	18.1	16.82	2.9	2.32	16.9	15.78
72	29.3	11.4	12.21	13.3	16.4	15.5	23.2	20.3
100	13.3	9.9	9.41	10.1	28.2	28.7	13.84	16.9
150	3.2	11.8	11.88	13.5	26.4	32.0	6.32	8.5
200	0.42	4.9	7.3	4.0	13.8	12.6	2.1	3.61
240	0.18	4.8	1.6	1.1	6.4	5.7	0.9	1.4

Samples Used for Factor Analysis 2

Seaton Carew Beach 2	Saltburn Beach	Beach N.of Saltburn	Marske Beach 1	South Gare Beach 10	Redcar Beach 3
-	0.39	-	0.16	-	0.64
-	0.3	0.28	0.02	-	0.8
0.01	2.3	1.07	0.76	0.06	1.4
0.02	6.11	4.52	0.98	0.12	5.41
0.2	14.6	18.32	4.78	3.8	1.7
11.2	36.33	43.29	34.36	35.2	13.82
62.55	37.09	30.8	54.36	54.81	65.78
25.2	2.3	1.49	4.36	5.91	14.78
0.5	0.03	-	0.04	0.07	0.2
0.1	-	-	-	-	-

Musselborough Beach 1	Hartlepool Yacht Club 3	Hartlepool Yacht Club 1	Crimdon Beach 1	Crimdon Beach 3
0.32	0.1	0.18	0.36	0.18
1.4	0.16	0.18	0.36	0.6
4.09	1.0	0.62	2.64	5.58
1.22	1.22	17.66	14.72	10.34
10.66	7.44	10.44	52.26	39.24
33.22	38.96	36.8	23.0	33.4
41.52	40.56	39.02	2.0	5.22
2.32	10.2	11.3	0.04	0.3
0.01	0.1	0.14	-	-
-	0.02	0.1	-	-

Droman Beach A	Droman Beach B	S. Gare Dune D	S. Gare Dune A	Cliffslip Huntcliff	Musselborough Sand Dune
-	-	-	-	-	0.1
0.27	1.4	-	-	0.07	0.17
2.9	13.59	0.02	0.01	0.45	2.46
10.34	19.12	0.28	0.11	1.44	3.99
23.58	29.01	5.21	2.63	8.42	7.09
44.18	27.62	48.04	35.02	38.8	28.73
5.22	17.05	8.54	43.68	58.51	46.85
0.3	1.39	0.51	2.45	3.5	2.72
-	0.01	0.01	0.04	0.02	0.08
-	-	0.01	-	-	0.01

Crimdon Dune 2	Crimdon Dune 18'	Crimdon Dune 33'	Crimdon Dune 5'	Droman Dune B
-	-	-	-	-
0.02	-	-	-	0.07
0.12	0.05	0.1	0.2	1.5
1.0	0.8	0.2	0.2	8.35
26.4	36.24	10.8	7.0	22.98
61.96	57.2	62.44	61.56	43.8
53.87	9.6	4.58	24.4	27.54
3.1	0.26	0.2	1.4	1.76
0.07	-	-	-	0.02
-	-	-	-	-

Droman Dune A	Saltburn River Sand	Thorpe Thewles 4	Saltburn 1967 Flood	Thorpe Thewles 1	Thorpe Thewles 2
-	-	-	4.07	1.41	1.63
0.01	0.06	0.05	6.61	3.01	2.96
1.55	1.01	0.32	29.27	24.78	19.92
9.53	5.42	5.18	19.08	21.8	19.32
24.85	18.92	18.3	15.13	20.78	20.93
42.08	35.51	36.38	8.24	11.27	12.84
18.98	24.03	24.37	4.94	6.11	6.74
2.69	10.42	10.12	4.33	4.62	6.06
0.27	2.49	2.4	1.69	1.77	2.39
-	0.83	0.93	0.89	1.15	1.21

Billingham Beck 1	Billingham Beck 2	Offshore SLS 10	Offshore SLS 4	Offshore LOC 2
0.86	0.04	0.01	0.05	0.08
1.82	0.2	0.02	0.29	0.08
27.54	6.04	0.54	1.28	1.21
29.6	11.62	0.38	1.59	0.4
23.4	24.6	0.61	5.9	0.78
9.2	23.56	1.8	18.93	2.8
3.24	15.4	14.53	19.2	23.42
1.76	10.12	48.63	34.64	53.57
0.46	3.0	19.05	11.26	8.95
0.22	1.3	6.54	3.08	2.26

Offshore SLS 3	Offshore LOC 12	Offshore R5	Offshore R1	Offshore LOC 16	Offshore SLS 9	Offshore R2
0.06	0.2	2.3	1.01	0.02	0.27	0.25
0.6	0.45	1.3	0.61	0.26	0.52	0.04
2.31	2.6	1.13	1.29	2.26	1.3	1.35
1.3	2.89	0.8	0.5	4.89	0.48	0.87
4.43	13.49	1.86	0.59	18.29	0.7	1.03
15.21	46.15	15.32	8.23	41.85	2.8	11.97
2.02	28.91	59.59	61.91	27.23	18.61	59.1
27.6	4.09	15.9	24.11	4.33	55.79	22.41
9.67	0.1	0.58	0.62	0.11	15.3	1.26
4.91	0.01	0.09	0.1	0.01	2.09	0.18

Offshore R8	Offshore LOC 7	Offshore LOC 1	Offshore SLS 6	Offshore LOC 10	Offshore R9	Droman Offshore A Site 1
-	0.19	0.06	0.08	0.09	-	-
0.09	0.47	0.39	0.42	0.3	0.26	3.2
0.5	1.95	1.95	1.25	1.7	0.97	9.09
0.31	2.25	1.12	0.99	4.45	0.58	13.8
0.39	7.45	2.48	2.72	18.9	0.88	27.2
2.13	23.9	6.2	10.3	45.3	17.3	34.33
33.42	37.13	8.0	18.3	23.48	63.09	10.58
53.62	23.61	31.07	49.98	4.93	15.75	1.5
7.71	1.58	18.5	10.78	0.1	0.48	0.25
0.59	0.11	10.39	2.46	0.12	0.03	0.05

Droman Offshore B Site 1	Droman Offshore A Site 2	Droman Offshore B Site 2	Droman Offshore C Site 2	Coatham Stob Yellow Sand 1	Coatham Stob Yellow Sand 3
-	0.01	-	-	0.1	0.01
1.9	1.01	0.83	0.68	0.06	0.02
6.51	3.65	5.01	4.7	0.41	0.7
11.65	9.59	12.4	12.41	2.71	3.95
25.28	24.2	27.71	25.81	8.92	12.22
36.3	40.93	37.28	37.88	26.5	29.65
15.55	17.6	13.3	14.7	31.97	28.2
2.21	2.75	2.8	3.15	18.71	15.65
0.31	0.36	0.51	0.42	5.34	4.29
0.1	0.1	0.11	0.09	1.51	1.42

Coatham Stob 1	Coatham Stob 4	Coatham Stob 4 2	Coatham Stob 4 1	Coatham Stob 5 2	Coatham Stob Same as 3	Coatham Stob 3
11.53	2.5	0.12	0.3	12.5	0.67	-
2.22	0.78	0.42	0.61	2.7	0.5	0.07
6.24	4.9	1.37	1.38	10.53	0.78	0.04
13.12	8.78	2.8	2.0	23.2	4.4	0.85
16.88	12.95	9.36	5.78	23.37	17.58	4.48
23.2	21.3	31.19	20.72	17.8	39.38	22.09
13.71	21.6	32.07	35.16	6.61	23.66	33.85
6.4	15.79	15.57	22.4	1.81	8.6	22.95
2.08	4.8	3.6	5.8	0.4	1.83	7.12
0.82	1.6	1.03	1.88	0.15	0.58	2.31

Brierton Top 3A	Brierton 2C	Brierton Mid 3B	Brierton 3C Bottom	Brierton C4
1.92	0.28	0.04	0.02	0.04
0.76	5.6	0.08	0.02	0.16
1.2	21.44	0.4	0.08	0.66
2.6	19.10	0.8	0.18	3.02
18.16	20.6	6.22	1.8	19.8
32.84	15.0	19.16	15.0	44.88
23.64	9.32	21.84	26.2	20.84
11.78	5.98	22.76	27.0	6.56
2.8	1.4	10.02	11.2	1.36
1.2	0.8	5.94	6.18	0.42

Brierton 4C Above 3C	Brierton A2	Brierton C2	Brierton C5
0.18	1.58	0.6	0.14
0.2	2.2	0.46	0.2
1.22	6.4	2.24	0.8
2.42	10.98	6.0	2.94
12.94	26.76	21.8	18.92
31.56	23.46	40.36	44.16
28.92	13.6	19.04	23.0
15.2	8.04	5.6	6.5
3.3	2.3	1.14	1.12
1.2	0.96	0.44	0.4

Wynyard Basal Sand	Wynyard C	Wynyard A	Wynyard 3	Wynyard 2
-	0.4	0.4	0.2	0.6
-	0.84	0.84	0.38	0.9
0.04	10.0	13.6	5.56	8.9
0.06	24.2	16.5	21.5	20.64
0.22	37.4	37.7	42.0	39.76
2.7	17.3	21.26	18.24	17.5
16.2	5.04	4.4	6.42	5.6
35.02	1.7	17.4	2.8	2.46
16.16	0.2	0.4	0.78	0.72
0.2	-	0.12	0.22	0.28

Hurworth 3	Hurworth H3	Hurworth 1	Hurworth 5	Hurworth H6
-	-	-	-	-
-	-	-	-	-
0.1	0.02	-	0.04	0.04
0.2	0.2	0.02	0.07	0.38
0.24	8.6	0.14	0.11	13.4
0.44	51.5	0.42	0.22	52.84
13.1	31.5	13.38	9.16	25.78
49.47	6.7	48.12	47.83	5.44
22.61	0.8	23.59	25.7	0.7
14.02	0.34	13.95	15.47	0.26

Newton Bewley 2	Girsby Flat	Eaglescliffe 3	Eaglescliffe 4	Rockcliffe 1	Stockton Norton 1
0.3	-	0.05	0.02	0.2	-
0.66	1.36	0.1	0.02	0.22	0.07
14.52	5.4	0.2	0.1	0.31	15.4
15.9	5.2	0.2	0.11	0.88	38.8
17.01	7.2	0.41	0.22	3.0	20.68
12.63	15.53	1.85	1.88	27.01	12.38
9.52	19.33	9.8	23.79	46.62	4.55
11.77	17.78	44.32	56.35	13.63	2.09
7.49	8.3	23.22	12.6	3.25	1.03
1.52	3.28	7.22	2.1	1.01	0.51

Ireland Interglac Beach	Edinburgh Raised Sand	Edinburgh Fluvio-Glacial	Edinburgh Raised Marine	Edinburgh Raised Marine
-	-	-	-	-
0.05	0.01	-	0.01	-
0.96	0.02	0.1	0.06	0.18
2.32	0.11	0.24	0.06	0.22
8.5	0.92	1.28	0.07	0.23
21.31	16.62	15.77	1.6	4.08
24.26	37.31	38.8	23.7	26.91
23.8	27.49	31.07	45.6	48.92
10.3	11.29	7.8	21.95	13.31
-	2.1	2.14	3.27	2.51

APPENDIX 5

Mineralogical Data

Samples used in Factor Analysis 2

1) Heavy Minerals (Weights in Grams)

Beach	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Seaton Carew Beach 2				
B. S. Sieves				
72	22.859	22.843	22.643	0.945
100	61.53	61.477	60.640	1.419
150	12.674	12.612	11.742	7.354
200	--	--	--	--
Saltburn Beach				
72	36.317	36.271	35.427	2.451
100	46.561	46.550	45.513	2.251
150	2.453	2.411	2.025	17.448
200	--	--	--	--
Beach North of Saltburn				
72	41.501	41.475	40.740	1.834
100	21.570	21.560	21.064	2.346
150	0.603	0.600	0.545	9.618
200	0.029	0.028	0.021	27.586
Marske Beach (1)				
72	32.300	32.265	31.724	1.783
100	34.842	34.807	34.379	1.329
150	2.016	2.008	1.849	8.284
200	--	--	--	--
South Gare 10				
72	38.506	38.490	38.081	1.104
100	52.395	52.379	51.889	0.966
150	4.654	4.650	4.226	9.196
200	--	--	--	--

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Redcar Beach (3)				
72	26.014	26.007	25.697	1.218
100	56.864	56.830	56.308	0.978
150	7.819	7.812	6.974	10.807
200	--	--	--	--
Musselborough Beach				
72	38.732	38.621	36.694	5.262
100	42.550	42.464	41.166	3.253
150	2.460	2.397	2.060	16.260
H.Y.C. Beach 3				
72	41.114	40.990	40.219	2.177
100	39.735	39.614	38.669	2.683
150	10.388	10.273	9.914	4.563
H.Y.C. Beach 1				
72	40.507	40.352	39.618	2.195
100	37.691	37.623	36.760	2.470
150	10.106	10.076	9.575	5.254
Crimdon Beach 1				
72	28.432	28.399	27.807	2.198
100	3.641	3.630	3.463	4.889
150	0.076	0.076	0.054	28.947
Crimdon Beach 3				
72	35.265	35.240	34.536	2.067
100	5.027	5.017	4.739	5.729
150	0.175	0.172	0.136	22.286
Droman Beach A				
72	44.168	44.167	44.045	8.278
100	17.067	17.067	16.978	0.521
150	1.379	1.379	1.337	3.045
200	0.781	0.781	0.467	41.844

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
S. Gare Dune D				
72	42.570	42.550	42.209	0.848
100	50.477	50.453	50.085	0.776
150	2.249	2.238	2.166	3.690
S. Gare Dune A				
72	51.254	51.210	50.527	1.418
100	39.725	39.685	39.221	1.269
150	2.039	2.017	1.945	4.610
Cliff Slip. Huntcliff				
72	40.100	40.089	39.503	1.489
100	50.448	50.437	49.755	1.374
150	2.895	2.870	2.541	12.228
Musselborough Sand Dune				
72	40.379	40.292	39.081	3.214
100	44.123	44.002	42.501	3.676
150	1.704	1.634	1.316	22.770
200	0.107	0.092	0.052	51.402
Crimdon Dune 2				
72	64.030	64.003	63.376	1.021
100	24.977	24.951	24.228	2.999
150	1.275	1.253	1.098	13.882
Crimdon Dune 18'				
72	59.396	59.356	58.597	1.345
100	3.691	3.684	3.482	5.662
150	0.064	0.062	0.042	34.375
Crimdon Dune 33'				
72	64.912	64.891	64.192	1.109
100	23.223	23.193	22.188	4.457
150	1.053	1.027	0.834	20.798

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Crimdon Dune 5'				
72	60.407	60.382	59.891	0.854
100	30.582	30.563	29.908	2.204
150	1.785	1.766	1.616	9.468
Droman Dune B				
72	42.062	42.055	41.572	1.164
100	18.976	18.967	18.077	4.737
150	2.686	2.676	1.360	49.367
200	0.257	0.255	0.013	94.941
Droman Dune A				
72	43.788	43.781	43.354	0.991
100	20.732	20.727	20.070	3.193
150	2.375	2.368	1.175	50.526
200	0.198	0.195	0.009	95.454
Saltburn River Sand				
72	40.302	40.249	37.260	7.548
100	21.173	21.083	20.007	5.507
150	8.912	8.890	--	--
200	2.103	2.094	1.856	0.427
Thorpe Thewles River Sand (4)				
72	13.965	13.954	13.712	1.812
100	6.042	6.032	5.938	1.721
150	3.826	3.818	3.750	1.986
200	1.615	1.608	1.577	2.353
Saltburn River Sand				
Oct. 1967 Flood				
72	38.143	38.040	35.082	8.025
100	21.451	21.379	20.240	5.645
150	8.478	8.447	7.959	6.122
200	1.926	1.917	1.833	31.776

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Thorpe Thewles Beck (1)				
72	9.074	9.061	8.814	2.865
100	5.776	5.765	5.664	1.939
150	4.191	4.182	4.091	2.386
200	1.941	1.932	1.837	5.358
Thorpe Thewles Beck (2)				
72	12.848	12.830	12.549	2.327
100	7.126	7.116	6.977	2.091
150	4.916	4.909	4.832	1.709
200	2.188	2.180	2.151	1.691
Billingham Beck (1)				
72	25.490	25.464	25.254	1.428
100	16.325	16.311	16.072	1.550
150	9.908	9.891	9.714	1.958
200	3.452	3.446	3.412	1.159
Billingham Beck 2				
72	8.196	8.185	8.029	2.037
100	3.050	3.045	2.989	2.000
150	1.328	1.324	1.238	6.777
200	0.455	0.455	0.446	1.978
Offshore S.L.S. 10				
72	2.046	2.030	1.954	4.496
100	13.307	13.277	12.932	2.818
150	47.931	47.902	46.769	2.424
200	20.745	20.704	20.283	2.227
Offshore S.L.S. 4				
72	19.397	19.386	19.200	1.016
100	19.974	19.960	19.746	1.141
150	33.719	33.693	33.002	2.126
200	13.040	13.013	12.833	1.587

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Offshore Loc. 2.				
72	2.174	2.161	2.099	3.450
100	18.114	18.101	17.770	1.899
150	57.856	57.805	56.690	2.015
Offshore S.L.S. 3.				
72	17.924	17.918	17.659	1.478
100	21.590	21.555	21.047	2.515
150	28.413	28.367	27.554	3.058
200	11.124	11.065	10.896	2.050
Offshore Loc. 12				
72	49.629	49.629	48.826	1.618
100	28.804	28.797	27.678	3.909
150	3.118	3.095	2.714	12.957
200	0.127	0.123	0.097	23.622
Offshore R.5.				
72	16.519	16.519	16.273	1.489
100	57.488	57.488	56.766	1.256
150	17.549	17.543	17.093	2.598
200	0.619	0.616	0.592	4.361
Offshore R.1.				
72	9.709	9.709	9.516	1.988
100	65.582	65.582	64.911	1.023
150	20.380	20.380	19.876	2.473
200	0.434	0.430	0.409	5.760
Offshore Loc. 16.				
72	43.284	43.268	42.730	1.280
100	27.240	27.240	26.351	3.263
150	4.120	4.086	3.941	4.345
Offshore S.L.S. 9.				
72	3.082	3.065	2.996	2.790
100	18.661	18.648	18.256	2.170
150	57.585	57.533	55.767	3.157
200	14.251	14.165	13.370	6.182

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Offshore R.2.				
72	12.302	12.293	12.104	1.609
100	57.979	57.962	55.184	4.821
150	22.331	22.319	21.925	1.818
200	0.889	0.878	0.863	2.925
Offshore R.8.				
72	1.783	1.781	1.723	3.365
100	25.096	25.088	24.708	1.546
150	60.470	60.402	58.126	3.876
200	9.409	9.364	8.864	5.792
Offshore Loc.7.				
72	21.362	21.336	20.987	1.755
100	37.560	37.512	35.863	4.518
150	31.385	31.271	29.424	6.248
200	1.701	1.664	1.543	9.289
Offshore Loc.1.				
72	6.937	6.726	6.453	6.977
100	8.455	8.430	8.151	3.595
150	34.143	34.054	33.371	2.261
200	21.789	21.651	21.124	3.051
Offshore S.L.S.6.				
72	11.379	11.369	10.971	3.585
100	18.288	18.271	17.517	4.216
150	47.719	47.662	46.453	2.653
200	12.492	12.427	12.207	2.281
Offshore Loc.10.				
72	44.807	44.766	44.127	1.518
100	26.821	26.783	25.955	3.229
150	5.800	5.774	5.531	4.638
200	0.288	0.288	0.264	8.333

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Offshore R.9.				
72	18.350	18.330	18.170	0.981
100	64.021	63.996	63.602	0.654
150	14.255	14.242	13.918	2.364
200	0.275	0.267	0.253	8.000
Droman Offshore A. Site 1.				
72	34.336	34.336	33.837	1.453
100	10.551	10.547	10.202	3.307
150	1.484	1.480	1.330	10.377
200	0.232	0.228	0.202	12.931
Droman Offshore B. Site 1.				
72	36.300	36.300	36.098	0.556
100	15.525	15.525	15.402	0.792
150	2.187	2.187	2.120	3.063
200	0.286	0.285	0.270	5.594
Droman Offshore A. Site 2.				
72	40.927	40.925	40.591	0.820
100	17.552	17.548	17.242	1.766
150	2.705	2.701	2.487	8.059
200	0.310	0.310	0.274	11.612
Droman Offshore B. Site 2.				
72	37.235	37.234	36.888	0.931
100	13.271	13.270	13.018	1.906
150	2.759	2.757	2.646	4.095
200	0.480	0.480	0.449	6.458
Droman Offshore C. Site 2.				
72	37.883	37.883	37.641	0.638
100	14.699	14.698	14.510	1.285
150	3.159	3.157	3.065	2.975
200	0.433	0.431	0.411	5.080

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Coatham Stob Yellow Sand (1)				
72	29.581	29.547	28.883	2.360
100	29.903	29.846	29.179	2.421
150	18.590	18.564	18.045	2.932
200	5.200	5.188	4.880	6.154
Coatham Stob Yellow Sand 3.				
72	33.048	33.026	32.279	2.327
100	27.777	27.743	27.119	2.369
150	13.569	13.551	13.230	2.498
200	3.227	3.196	3.138	2.758
Coatham Stob 4.				
72	25.219	25.175	24.594	2.478
100	20.168	20.133	19.753	0.173
150	11.861	11.838	11.389	3.979
200	3.209	3.190	3.147	1.932
Coatham Stob 1.				
72	23.945	23.908	23.247	2.915
100	12.490	12.438	12.068	3.379
150	4.914	4.868	4.564	7.122
200	1.452	1.429	1.410	2.892
Coatham Stob Same as 3.				
72	41.154	41.112	39.781	3.336
100	15.714	15.690	15.253	2.934
150	5.181	5.069	4.972	4.034
200	1.045	1.036	0.984	5.837
Coatham Stob. 4 (2)				
72	37.616	37.602	36.414	3.195
100	30.516	30.501	29.704	2.660
150	13.874	13.862	13.491	2.760
200	2.690	2.680	2.614	2.825

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Coatham Stob 4 (2)				
72	29.626	29.606	28.894	2.471
100	32.204	32.181	31.552	2.024
150	18.705	18.698	18.324	2.037
200	4.242	4.232	4.150	2.169
Coatham Stob 5 (2)				
72	7.953	7.944	7.453	6.287
100	4.174	4.160	3.951	5.007
150	0.669	0.669	0.633	5.381
Coatham Stob 3.				
72	30.928	30.899	30.164	2.470
100	30.351	30.321	29.917	1.430
150	19.460	19.441	18.876	3.001
200	6.189	6.161	5.934	4.120
Brierton Top 3A.				
72	30.060	30.037	29.295	2.545
100	27.080	27.060	26.452	2.319
150	14.227	14.218	13.854	2.622
200	4.074	4.070	3.992	2.013
Brierton 2C.				
72	12.638	12.572	11.727	7.208
100	6.662	6.641	6.395	4.008
150	3.249	3.241	2.827	12.989
200	0.838	0.834	0.811	3.222
Brierton M18 3B				
72	20.260	20.223	19.744	2.547
100	21.019	20.995	20.556	2.203
150	24.211	24.203	23.569	2.652
200	11.320	11.256	11.154	1.466

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Brierton 3C Bottom				
72	17.481	17.466	17.175	1.750
100	27.782	27.761	27.169	2.206
150	25.136	25.113	24.731	1.611
200	11.759	11.727	11.623	1.156
Brierton 4C above 3C				
72	33.329	33.295	32.420	2.727
100	28.594	28.587	27.983	2.137
150	15.499	15.494	15.289	1.355
200	3.402	3.398	3.359	1.264
Brierton A2				
72	25.116	25.077	24.164	3.790
100	14.115	14.097	13.690	3.011
150	7.500	7.492	7.302	2.640
200	2.518	2.514	2.464	2.144
Brierton C2				
72	41.935	41.310	40.079	4.426
100	19.894	19.854	19.114	3.921
150	5.023	5.014	4.794	4.559
200	1.094	1.094	1.035	5.393
Brierton C5				
72	45.775	45.759	44.411	2.980
100	23.654	23.625	22.824	3.509
150	6.026	6.016	5.785	3.999
200	1.099	1.099	1.075	2.184
Wynyard Basal Sand				
72	3.041	3.038	2.958	2.729
100	21.238	21.221	20.937	1.417
150	33.090	33.052	32.506	1.765
200	13.153	13.136	10.870	17.357

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Wynyard C.				
72	19.759	19.676	18.495	6.397
100	5.795	5.771	5.544	4.331
150	1.740	1.734	1.687	3.046
200	0.310	0.310	0.295	4.839
Wynyard A.				
72	22.857	22.785	21.749	4.847
100	4.326	4.305	4.118	4.808
150	1.312	1.301	1.269	3.277
200	0.274	0.272	0.267	2.555
Wynyard 3				
72	19.203	19.155	18.166	5.400
100	5.960	5.948	5.732	3.825
150	2.133	2.126	2.077	2.625
200	0.636	0.636	0.621	2.358
Wynyard 2.				
72	18.887	18.824	17.667	6.459
100	5.584	5.565	5.332	4.513
150	1.991	1.984	1.538	22.752
200	0.604	0.603	0.590	2.318
Hurworth 3				
72	54.259	54.233	52.896	2.512
100	31.583	31.565	30.450	3.587
150	5.384	5.374	5.115	4.996
200	0.614	0.612	0.572	6.840
Hurworth H3				
72	0.356	0.351	0.335	5.899
100	14.052	14.034	13.700	2.505
150	48.625	48.597	47.802	1.692
200	21.703	21.681	21.367	1.548

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Hurworth 1				
72	56.685	56.662	54.698	3.505
100	25.107	25.074	23.164	7.739
150	4.306	4.289	4.009	6.897
200	0.556	0.556	0.522	6.115
Hurworth 5				
72	51.631	51.614	50.163	2.843
100	33.415	33.407	31.997	4.244
150	6.162	6.154	6.021	2.288
200	0.873	0.873	0.834	4.467
Hurworth H6				
72	0.255	0.222	0.215	4.444
100	11.846	11.845	11.659	1.578
150	42.892	42.874	41.869	2.385
200	22.861	22.837	22.336	2.296
Newton Bewley 2				
72	13.145	13.116	12.711	3.299
100	9.639	9.629	9.460	1.857
150	10.968	10.948	10.892	0.693
200	5.618	5.581	5.557	1.086
Girsby Flat				
72	15.581	15.549	15.301	1.797
100	19.390	19.390	19.115	1.418
150	17.813	17.813	17.714	0.556
200	8.328	8.324	8.238	1.081
Eaglescliffe 3				
72	1.841	1.833	1.530	16.893
100	9.832	9.827	9.593	2.431
150	44.400	44.398	43.846	1.248
200	23.268	23.250	22.854	1.779

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Eaglescliffe 4				
72	1.882	1.872	1.804	4.144
100	23.846	23.839	22.678	4.898
150	56.412	56.398	55.426	1.748
200	12.641	12.630	11.800	6.653
Rockcliffe				
72	27.072	27.071	26.570	1.854
100	46.709	46.705	45.942	1.642
150	13.686	13.674	12.535	8.410
200	3.267	3.256	3.137	3.979
Stockton-Norton 1				
72	12.409	12.400	12.023	3.111
100	4.555	4.547	4.374	3.974
150	2.091	2.084	1.994	4.639
200	1.037	1.034	1.005	0.289
Ireland Beach				
72	21.369	21.330	20.995	1.750
100	24.317	24.303	23.605	2.928
150	23.854	23.844	23.202	2.733
200	10.311	10.298	10.197	1.106
Edinburgh Raised Sand				
72	3.949	3.938	3.748	5.090
100	34.439	34.354	33.224	3.527
150	43.647	43.537	42.221	3.267
200	12.276	12.167	11.533	6.052
Edinburgh Raised Sand				
72	3.414	3.405	3.273	4.130
100	36.275	36.083	35.206	2.947
150	46.379	46.282	45.104	2.749
200	10.229	10.138	9.493	7.195

	Weight	Weight After Hand Magnet	Weight After Electro-Magnet	% Weight Loss
Edinburgh Raised Sand				
72	1.620	1.609	1.547	4.506
100	29.627	29.566	28.849	2.626
150	48.607	48.533	47.305	2.679
200	13.894	13.834	13.480	2.980
Edinburgh Fluvio-Glacial				
72	20.457	20.397	19.053	6.863
100	38.272	38.223	36.364	4.985
150	28.437	28.067	26.595	6.477
200	7.346	7.198	6.655	9.406

Other Sedimentary Data

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Seaton Carew Beach 2					
B.S. Standard Sieves					
72	0.0	15	1	138	18
100	0.0	2	1	140	
150	0.0	2	2	120	
200	trace	0.0	34	60	
Saltburn Beach					
72	0.0	28	10	182	19
100	0.0	19	10	170	
150	0.0	11	20	400	
200	0.0	0.0	0.0	79	
Beach North of Saltburn					
72	0.0	32	0.0	103	20
100	0.0	31	0.0	79	
150	0.0	28	10	68	
200	0.0				
Marske Beach (1)					
72	0.0	41	0.0	303	17
100	0.0	5	0.0	130	
150	1.0	4	0.0	114	
200					
South Gare 10					
72	0.0	4	0.0	310	18
100	3	3	0.0	203	
150	0.0	2	0.0	123	
200					

	Micra (grains /1000)	Rock Frag-ments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Redcar Beach (3)					
72	0.0	38	10	413	19
100	0.0	20	8	158	
150	1	4	2	123	
200	0.0	3	2	98	
Musselborough Beach					
72	0.0	83	3	242	17
100	0.0	62	trace	149	
150	0.0	42	0.0	82	
H.Y.C. Beach (3)					
72	0.0	15	40	20	
100	1	10	9	19	
150	8	0.0	7	3	
H.Y.C. Beach (1)					
72	trace	22	110	610	16
100	trace	12	26	441	
150	20	3	39	101	
Crimdon Beach (1)					
72	0.0	0.0	7	30	19
100	0.0	0.0	10	20	
150	0.0	0.0	11	19	
Crimdon Beach (3)					
72	trace	5	10	40	17
100	trace	2	53	41	
150	trace	2	79	40	
Droman Beach A.					
72	1	8	0.0	908	18
100	2	3	0.0	878	
150	0.0	3	0.0	803	
200	-	-	-	-	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Droman Beach B.					
72	3	2	0.0	623	20
100	2	1	0.0	568	
150	0.0	2	0.0	610	
200	-	-	-	-	
S. Gare Dune D.					
72	0.0	5	0.0	155	13
100	0.0	8	1	89	
150	0.0	2	0.0	152	
S. Gare Dune A.					
72	0.0	4	0.0	84	10
100	0.0	32	4	121	
150	0.0	2	0.0	89	
Cliff Slip Huntcliff					
72	0.0	2	1	7	8
100	0.0	10	0.0	7	
150	0.0	3	20	20	
Musselborough Sand Dune					
72	0.0	72	10	101	13
100	0.0	50	2	109	
150	0.0	4	1	111	
200	0.0	2	2	45	
Crimdon Dune 2					
72	0.0	18	0.0	32	12
100	0.0	18	15	38	
150	0.0	24	25	56	
Crimdon Dune 18'					
72	0.0	3	0.0	3	11
100	0.0	21	12	98	
150	0.0	23	2	82	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Crimdon Dune 33'					
72	0.0	5	0.0	110	14
100	0.0	0.0	3	80	
150	0.0	10	20	110	
Crimdon Dune 5'					
72	0.0	10	0.0	101	12
100	0.0	20	2	70	
150	0.0	15	15	48	
Droman Dune B.					
72	0.0	3	0.0	586	14
100	0.0	2	0.0	632	
150	0.0	0.0	0.0	203	
200	0.0	4	0.0	58	
Droman Dune A					
72	0.0	1	0.0	678	11
100	0.0	5	0.0	312	
150	0,0	3	0.0	88	
200	0.0	2	0.0	59	
Saltburn River Sand					
72	0.0	140	Trace	0.0	8
100	8	130	28	0.0	
150	7	40	25	0.0	
200	10	28	29	0.0	
Thorpe Thewles River Sand 4.					
72	1	33	8	0.0	9
100	1	14	9	0.0	
150	4	12	10	0.0	
200	8	0.0	4	0.0	

	Micra (grains /1000)	Rock Frag-ments (grains /1000)	Coal (grains /1000)	Shell (grains /1000	Surface Texture
Saltburn River Sand Oct. 1967 Flood					
72	trace	30	0.0	0.0	9
100	1	11	0.0	0.0	
150	0.0	0.0	0.0	0.0	
200	0.0	0.0	0.0	0.0	
Thorpe Thewles Beck 1.					
72	0.0	530	0.0	0.0	7
100	0.0	361	0.0	0.0	
150	1	239	38	0.0	
200	0.0	219	36	0.0	
Thorpe Thewles Beck 2.					
72	0.0	90	0.0	trace	10
100	0.0	50	0.0	trace	
150	0.0	26	5	0.0	
200	0.0	8	27	0.0	
Billingham Beck (1)					
72	2	130	10	0.0	9
100	0.0	30	2	0.0	
150	2	34	2	0.0	
200	1	40	11	0.0	
Billingham Beck 2.					
72	0.0	40	0.0	0.0	8
100	0.0	10	0.0	0.0	
150	6	65	21	0.0	
200	2	73	18	0.0	
Offshore S.L.S.10					
72	22	20	434	251	13
100	2	7	272	107	
150	1	3	181	84	
200	2	0.0	140	61	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Offshore S.L.S. 4					
72	0.0	30	10	168	14
100	0.0	31	8	111	
150	3	13	7	71	
200	9	2	173	4	
Offshore LOC 2.					
72	10	0.0	513	335	12
100	1	38	270	104	
150	19	0.0	218	114	
Offshore S.L.S.3					
72	0.0	11	62	359	14
100	0.0	3	20	203	
150	3	4	85	110	
200	14	4	90	18	
Offshore LOC.12					
72	2	11	7	160	15
100	8	11	13	90	
150	3	8	43	92	
200	5	23	80	41	
Offshore R.5					
72	0.0	10	10	362	9
100	0.0	7	8	158	
150	trace	3	4	92	
200	trace	trace	3	78	
Offshore R.1					
72	5	8	12	303	12
100	2	trace	2	212	
150	trace	4	2	83	
200	3	0.0	23	91	
Offshore LOC.16					
72	0.0	40	31	310	14
100	0.0	10	30	150	
150	0.0	3	45	111	

	Micra (grains /1000)	Rock Frag-ments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Offshore S.L.S.9					
72	0.0	37	142	264	12
100	0.0	36	15	111	
150	2	20	11	61	
200	1	18	49	2	
Offshore R.2					
72	0.0	10	0.0	170	8
100	0.0	0.0	0.0	10	
150	0.0	19	17	0.0	
200	0.0	7	2	3	
Offshore R.8					
72	0.0	3	11	372	11
100	1	5	7	103	
150	3	0.0	5	58	
200	5	0.0	2	20	
Offshore LOC.7					
72	0.0	29	21	60	13
100	0.0	19	50	68	
150	0.0	22	41	32	
200	trace	12	38	28	
Offshore LOC 1					
72	12	32	177	165	13
100	7	23	434	89	
150	70	15	111	48	
200	3	25	72	23	
Offshore S.L.S.6					
72	9	43	50	210	13
100	1	12	45	54	
150	trace	11	29	10	
200	trace	8	10	10	
Offshore LOC.10					
72	0.0	8	32	34	12
100	0.0	19	18	140	
150	trace	38	31	17	
200	0.0	12	4	51	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Offshore R.9					
72	trace	1	1	300	10
100	trace	0.0	1	51	
150	trace	0.0	3	30	
200	trace	0.0	5	11	
Droman Offshore A Site 1.					
72	5	9	0.0	450	12
100	4	48	0.0	500	
150	3	28	0.0	410	
200	4	12	0.0	420	
Droman Offshore B.Site 1					
72	8	25	0.0	580	14
100	0.0	12	0.0	420	
150	1	19	0.0	520	
200	0.0	135	0.0	350	
Droman Offshore A.Site 2.					
72	0.0	80	0.0	400	15
100	0.0	55	0.0	425	
150	0.0	36	0.0	350	
200	0.0	142	0.0	284	
Droman Offshore B.Site 2.					
72	0.0	11	0.0	743	11
100	0.0	4	0.0	648	
150	0.0	5	0.0	724	
200	0.0	35	0.0	803	
Droman Offshore C. Site 2.					
72	2	17	0.0	621	10
100	1	13	0.0	785	
150	0.0	15	0.0	652	
200	0.0	65	0.0	429	
Coatham Stob Yellow Sand 1.					
72	0.0	41	8	0.0	11
100	0.0	10	3	0.0	
150	5	50	0.0	0.0	
200	12	15	0.0	trace	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Coatham Stob Yellow Sand 3.					
72	trace	23	2	0.0	7
100	0.0	30	31	0.0	
150	trace	20	4	0.0	
200	trace	13	10	0.0	
Coatham Stob 4					
72	10	83	23	0.0	14
100	10	41	17	0.0	
150	11	18	trace	0.0	
200	10	0.0	4	0.0	
Coatham Stob 1.					
72	0.0	39	2	0.0	11
100	0.0	21	38	0.0	
150	0.0	17	57	0.0	
200	5	0.0	78	0.0	
Coatham Stob, Same as 3.					
72	0.0	14	11	0.0	8
100	0.0	5	2	0.0	
150	0.0	3	0.0	0.0	
200	31	0.0	5	0.0	
Coatham Stob $4_{(2)}$					
72	0.0	54	22	trace	10
100	0.0	23	8	0.0	
150	0.0	15	2	0.0	
200	0.0	11	1	trace	
Coatham Stob $4_{(1)}$					
72	1	37	22	trace	9
100	3	32	20	trace	
150	10	33	20	trace	
200	11	3	21	trace	
Coatham Stob $5_{(2)}$					
72	0.0	70	32	trace	12
100	trace	42	25	trace	
150	1	41	10	trace	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Coatham Stob 3					
72	trace	18	10	0.0	11
100	trace	15	7	0.0	
150	1	2	27	0.0	
200	1	2	1	0.0	
Brierton, Top 3A					
72	0.0	165	3	0.0	7
100	0.0	45	15	0.0	
150	2	3	9	0.0	
200	5	2	12	0.0	
Brierton 2C					
72	0.0	130	11	0.0	6
100	1	42	12	0.0	
150	7	20	10	0.0	
200	5	0.0	10	0.0	
Brierton Mid 3B					
72	1	52	40	0.0	10
100	20	30	21	0.0	
150	8	19	11	0.0	
200	11	3	6	0.0	
Brierton 3C.Bottom					
72	0.0	61	27	0.0	8
100	4	40	30	0.0	
150	9	12	20	0.0	
200	8	2	10	0.0	
Brierton 4C above 3C					
72	1	71	28	0.0	9
100	2	22	10	0.0	
150	1	11	8	0.0	
200	trace	2	8	0.0	
Brierton A2					
72	trace	28	0.0	0.0	8
100	10	28	trace	0.0	
150	9	7	1	0.0	
200	11	0.0	2	0.0	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Brierton C2					
72	10	28	10	0.0	8
100	0.0	31	11	0.0	
150	3	30	8	0.0	
200	5	5	3	0.0	
Brierton C5					
72	0.0	62	trace	0.0	7
100	0.0	54	trace	0.0	
150	1	41	trace	0.0	
200	5	13	trace	0.0	
Wynyard Basal Sand					
72	2	332	10	0.0	13
100	1	96	3	0.0	
150	1	72	1	0.0	
200	2	60	20	0.0	
Wynyard C.					
72	trace	240	trace	0.0	6
100	trace	180	0.0	0.0	
150	trace	150	trace	0.0	
200	trace	160	trace	0.0	
Wynyard A.					
72	0.0	168	0.0	0.0	7
100	0.0	99	trace	0.0	
150	0.0	71	0.0	0.0	
200	1	41	0.0	0.0	
Wynyard 3.					
72	0.0	200	0.0	0.0	8
100	0.0	309	0.0	0.0	
150	0.0	260	trace	0.0	
200	0.0	260	trace	0.0	
Wynyard 2.					
72	0.0	180	0.0	0.0	7
100	0.0	130	5	0.0	
150	trace	103	0.0	0.0	
200	trace	71	0.0	0.0	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Hurworth 3					
72	trace	98	100	0.0	10
100	trace	10	20	0.0	
150	trace	10	15	0.0	
200	1	9	11	0.0	
Hurworth H.3					
72	111	233	183	0.0	11
100	84	70	53	0.0	
150	2	25	32	0.0	
200	2	0.0	10	0.0	
Hurworth 1.					
72	0.0	90	20	0.0	10
100	0.0	60	30	0.0	
150	0.0	170	11	0.0	
200	0.0	41	17	0.0	
Hurworth 5.					
72	0.0	39	11	0.0	12
100	0.0	31	10	0.0	
150	0.0	29	19	0.0	
200	0.0	42	23	0.0	
Hurworth H6					
72	106	100	75	0.0	14
100	29	30	45	0.0	
150	9	0.0	15	0.0	
200	2	0.0	15	0.0	
Newton Bewley 2.					
72	trace	250	0.0	0.0	8
100	trace	58	trace	0.0	
150	2	80	0.0	0.0	
200	2	8	0.0	0.0	
Girsby Flat					
72	234	521	178	0.0	10
100	92	183	42	0.0	
150	41	72	19	0.0	
200	10	20	2	0.0	

	Micra (grains /1000)	Rock Fragments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Eaglescliffe 3.					
72	50	341	149	0.0	12
100	20	110	28	0.0	
150	2	67	2	0.0	
200	11	6	1	0.0	
Eaglescliffe 4.					
72	70	682	73	0.0	14
100	59	151	20	0.0	
150	27	32	5	0.0	
200	1	2	3	0.0	
Rockcliffe					
72	1	41	30	0.0	11
100	1	24	19	0.0	
150	3	17	21	0.0	
200	1	7	61	0.0	
Stockton-Norton 1.					
72	0.0	18	8	0.0	12
100	2	3	1	0.0	
150	8	0.0	1	0.0	
200	22	0.0	0.0	0.0	
Ireland Beach					
72	0.0	2	0.0	1	17
100	0.0	1	0.0	2	
150	4	0.0	0.0	3	
200	2	0.0	0.0	3	
Edinburgh Raised Sand					
72	300	89	310	0.0	9
100	1	112	31	0.0	
150	5	13	50	0.0	
200	1	51	40	0.0	
Edinburgh Raised Sand					
72	70	90	61	0.0	10
100	2	20	15	0.0	
150	7	20	39	0.0	
200	2	4	3	0.0	

	Micra (grains /1000)	Rock Frag-ments (grains /1000)	Coal (grains /1000)	Shell (grains /1000)	Surface Texture
Edinburgh Raised Sand					
72	62	89	120	0.0	8
100	23	41	42	0.0	
150	3	52	60	0.0	
200	3	51	50	0.0	
Edinburgh Fluvial-glacial.					
72	5	72	72	0.0	11
100	1	40	18	0.0	
150	2	15	10	0.0	
200	3	4	7	0.0